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THE VASCULAR FLORA OF ISLA SOCORRO, MEXICO

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AND
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Department of Botany
San Diego Natural History Museum
San Diego, California 92112, USA

SAN DIEGO
SOCIETY OF NATURAL HISTORY

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Abstract. This is the first comprehensive report since 1931 on the vascular flora of Isla Socorro, a small isolated volcanic island in the Islas Revillagigedo off the west coast of Mexico. In the last 58 years the number of collections from the island has increased about seven-fold. The native flora comprises 117 species, 30 of them endemic to Socorro and 9 more to the Revillagigedos. Despite high endemism, there does not appear to have been an evolutionary radiation on the island. The flora is derived principally from western mainland Mexico, but particularly the endemic species show a strong affinity with plants of southern Baja California, and the closest relatives of a few species are found only in places even farther away. Dispersal by birds appears to account for the arrival of most species or their ancestors; drift and air flotation also are important among the non-endemics. Several species show increased woodiness on the island, and several others have denser pubescence or more compact inflorescences than do their mainland relatives. The vegetation is mostly low non-spiny scrub, but there is forest on the upper east slope and some grassland from shore to summit. Sheep and limited clearing for agriculture and for roads have disturbed the vegetation on the south side of the island and have allowed the naturalization of 47 introduced species. We describe six new taxa: *Aegopogon solisii* Levin, *Bidens socorrensis* Moran and Levin, *Botrychium socorrense* W. Wagner, *Castilleja socorrensis* Moran, *Lepechinia hastata* subsp. *socorrensis* Moran, and *Salvia pseudomisella* Moran and Levin. We make six new combinations: *Chamaesyce anthonyi* (T. S. Brandegee) Levin, based on *Euphorbia anthonyi*; *Cynanchum californicum* (Benth.) Moran, based on *Metastelma californicum*; *Cynanchum sonorensis* Moran, based on *Metastelma minutiflorum* Wiggins; *Spermacoce nesiotica* (Robinson) Levin, based on *Borreria nesiotica*; *Teucrium townsendii* subsp. *affine* (T. S. Brandegee) Moran, based on *T. affine*; and *Zapoteca formosa* subsp. *socorrensis* (I. M. Johnston) Levin, H. Hernández, & Moran, based on *Calliandra socorrensis*. We also refer to wider-ranging species the following taxa previously thought to be endemic to Isla Socorro: *Bulbostylis sepiacea* Kral, *Bursera nesopola* I. M. Johnston, *Nicotiana nesophila* I. M. Johnston, *Peperomia chrysolepida* Trel., *Phoradendron townsendii* Trel., and *Viguiera deltoidea* var. *townsendii* Vasey & Rose. Appendices list the known floras of islas Clarión (41 native and 1 introduced species) and San Benedicto (formerly 10 but now 6 native species).

Resumen. Este es el primer reporte comprehensivo desde 1931 sobre la flora de tejido vascular de la Isla Socorro, una isla volcánica aislada del grupo de las islas Revillagigedo en la costa occidental de México. En los últimos 58 años, el número de colecciones hechas en la isla han incrementado por siete veces. La flora nativa comprende 117 especies, 30 de ellas endémicas a la Isla Socorro y 9 otras a las Revillagigedo. No parece existir una irradiación evolutiva en la isla aunque existe gran endemismo en ellas. La flora proviene principalmente del oeste del México continental, pero en particular las especies endémicas demuestran una gran afinidad con plantas de Baja California Sur, y parentela con unas cuantas especies que se encuentran en lugares aún más lejanos. Dispersión por medio de aves parece ser la razón del arribo de la mayoría de las especies o de sus ancestros; corrientes marinas y de aire también son importantes con las inendémicas. Varias especies en la isla demuestran un incremento en su carácter maderoso, y algunas otras tienen una pubescencia más densa o una inflorescencia más compacta que la de sus parientes en el área continental. La vegetación consiste, en su mayoría de matorrales bajos y sin espinas, pero existe una selva en la cuesta superior oriental, así como pastizales de la playa hasta la cima. Algo de ganado ovino, así como claros para agricultura y creación de caminos han molestado a la vegetación en el lado sur de la isla, y han permitido la naturalización de 47 especies introducidas. Describimos seis taxa nuevas: *Aegopogon solisii* Levin, *Botrychium socorrense* W. Wagner, *Bidens socorrensis* Moran y Levin, *Castilleja socorrensis* Moran, *Lepechinia hastata* subespecie *socorrensis* Moran, y *Salvia pseudomisella* Moran y Levin. Creamos seis combinaciones nuevas: *Chamaesyce anthonyi* (T. S. Brandegee) Levin, basándose en *Euphorbia anthonyi*; *Cynanchum californicum* (Benth.) Moran, basándose en *Metastelma californicum*; *Cynanchum sonorensis* Moran, basándose en *Metastelma minutiflorum* Wiggins; *Spermacoce nesiotica* (Robinson) Levin, basándose en *Borreria nesiotica*; *Teucrium townsendii* subespecie *affine* (T. S. Brandegee) Moran, basándose en *T. affine*; y *Zapoteca formosa* subespecie *socorrensis* (I. M. Johnston) Levin, H. Hernández, y Moran, basándose en *Calliandra socorrensis*. También referimos a especies plias las siguientes taxa, previamente creídas ser endémicas a Isla Socorro: *Bulbostylis sepiacea* Kral, *Bursera nesopola* I. M. Johnston, *Nicotiana nesophila* I. M. Johnston, *Peperomia chrysolepida* Trel., *Phoradendron townsendii* Trel., y *Viguiera deltoidea* var. *townsendii* Vasey y Rose. Los apéndices describen las floras conocidas en las islas Clarión (41 especies nativas y una introducida) y San Benedicto (antes 10, pero ahora 6 especies nativas).

The Vascular Flora of Isla Socorro, Mexico

Geoffrey A. Levin and Reid Moran¹

INTRODUCTION

The Islas Revillagigedo are four scattered volcanic islands, Clarión, Roca Partida, San Benedicto, and Socorro, in the Pacific Ocean off the west coast of Mexico (Figure 1). They are true oceanic islands, never having been connected to the mainland (Richards 1957, Jehl and Parkes 1983). Isla Socorro, the largest (210 km²) and highest (1040 m), lies 460 km south-southwest of Cabo San Lucas, Baja California Sur, and 580 km west of Cabo Corrientes, on the Mexican mainland.

The earliest lists of vascular plants for the Revillagigedos are those of Vasey and Rose (1891) and Brandegee (1900b). The most important work on the flora has been the thorough study by Johnston (1931). Reporting mainly on the collections of H. L. Mason in 1925, Johnston also discussed all available earlier collections and analyzed the relationships of the flora. He listed 93 species known from Socorro and nine others he thought doubtful. He also listed 43 species from Clarión and 11 from San Benedicto; Roca Partida is a pinnacle devoid of vascular plants. Though a few later works have dealt specifically with Socorro plants (e.g., Svenson 1939, H. S. Gentry 1949, Howell 1949, Miranda 1960) and several scattered new records have appeared, no comprehensive flora has been published in the last half-century.

This flora is mainly the fruit of Moran's trips to Socorro in 1957, 1978, and 1981 and Levin's trips in 1987 and 1988, but also draws on other sources. The number of collections from Socorro has grown from under 200 seen by Johnston (1931) to over 1200 seen by us. On the basis of these specimens and current taxonomic treatments, we accept 117 species as native and 47 more as naturalized. We report 17 of the native species from Socorro for the first time, including four we propose as endemic new species, and we confirm for Socorro four species that Johnston thought doubtful. We also propose one endemic new species and one endemic new subspecies for plants already known on the island, but refer to wider-ranging species six taxa previously considered to be endemic to Socorro. In addition, we include much more information about species' abundance and distribution on the island than

could Johnston (1931), who had to rely on specimens with only scanty data.

Most place names used in this paper can be found in Figure 1, which we adapted from Richards and Brattstrom (1959). With three exceptions, these names appear on most recent maps of the island. Most Mexican maps use Cabo Regla for what we call Cabo Rule, and Cabo Chato for Cabo Middleton. We chose to use the older names in both cases. Caleta Castelán, the main landing at the south end of the island, is unnamed on most maps. Hanna (1926, fig. 5) showed it as the landing, but apparently considered it part of Bahía Braithwaite, and perhaps others did likewise. The cove received its current name shortly after the naval base was established in 1957 (Adem 1960). It has also been called Bahía Vargas Lozano, though we cannot find this name published before 1973 (Lewis 1973:178), and simply "The Cove" (Lewis 1973:174, U.S. Defense Mapping Agency Hydrographic/Topographic Center 1982). For two places without known proper names, we use descriptive names. The "summit plateau" is the relatively flat area east of the summit of Cerro Evermann at about 950 m, or about 90 m below the summit. The "caldera valley" is an undrained valley southeast of Cerro Evermann at an elevation of about 550 m.

CLIMATE

The Mexicans have been collecting meteorological data near the naval base on Isla Socorro since it was established in 1957. According to Medina (1978), mean monthly temperatures at the naval base vary between 19°C (January) and 28°C (July/August). The mean annual precipitation near sea level is 761 mm. Almost all the rain falls between July and October, half of it in August (mean of 140 mm) and September (mean of 240 mm). At lower elevations, the remainder of the year is quite dry, with no rain falling for months at a time. In contrast, the summit of the island frequently is engulfed by clouds and probably receives small amounts of moisture through much of the year. Thus, except at the summit, the climate is similar to that of the nearby Mexican mainland (Mosiño Alemán and García 1974:375–376).

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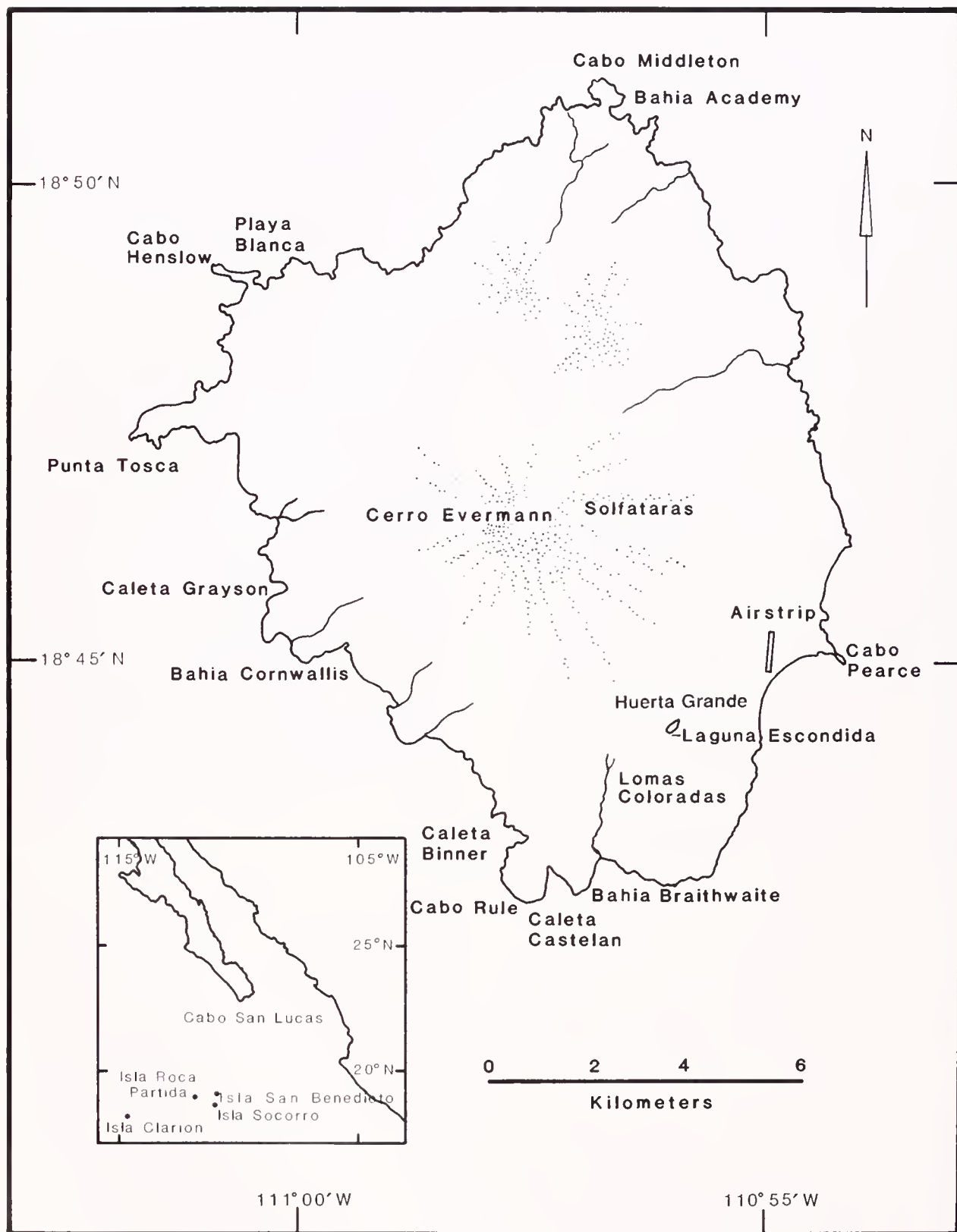


Fig. 1. Isla Socorro, Mexico, and the Islas Revillagigedos (inset). Adapted from Richards and Brattstrom (1959).

HUMAN IMPACTS

Except for two short-lived attempts at colonization, Socorro remained uninhabited until 1957, when the Mexican government established a naval base on Cabo Rule (Richards and Brattstrom 1959). Since then, feral house cats apparently have caused the extinction of one endemic bird and threaten at least one more (Jehl and Parkes 1982, 1983). Goats have not been introduced yet, but sheep brought between 1869 and 1887² still survive on the southern part of the island. They now range mainly over the southeastern slope, probably being limited by lack of fresh water. A large, gently sloping area north of Huerta Grande, between 300 and 450 m, is called "Llano de los Borregos" by the Mexican sailors stationed on the island. Sheep have denuded most of this area, leaving a few dying trees and shrubs. This area is now covered with annuals, especially *Mitracarpus hirtus*, *Aristida adscensionis*, and other, introduced, grasses. (We provide authors only for species not in the Catalogue.) With the perennial cover essentially gone, erosion is rapid and several large arroyos have developed. Higher, in the forest to about 700 m, the sheep have left few herbs and little undergrowth. The trees are old, generally in poor condition and with a lot of dead wood; young trees apparently cannot get established. F. Miranda (pers. comm.), however, suggested that the vegetation may have been relatively sparse in these areas even before the sheep were introduced. He also suggested (Miranda 1960) that grasslands such as that on Cabo Rule may have been favored by browsing of the scrub by sheep.

By 1903 only two weeds, *Eragrostis ciliaris* and *Tribulus cistoides*, had been found on Socorro. In 1955 Carlquist found *Dactyloctenium aegyptium*, and two years later Moran found only two more, *Cenchrus echinatus* and *Eragrostis tenella*. All three were scarce and apparently just getting started. Since the naval base was established in 1957, clearing for roads and for a

little planting has disturbed some parts of the south end, and traffic from the mainland has greatly increased. By 1988 the number of naturalized plants had grown to at least 47, mostly in these disturbed places and the overgrazed area north of Huerta Grande. More are sure to come.

Although sheep might be expected to carry seeds up, the only weeds known to have reached the summit of the island are *Eragrostis ciliaris*, found there by 1957, and *Mitracarpus hirtus*, found there in 1988. The Mexican navy now maintains a crude trail to the peak, making direct introduction of foreign plants to the interior of the island at least conceivable. Visits to other parts of the island have also increased. For each plant newly found since 1957, even in a remote area, we must therefore ask whether it could have been introduced. Especially with plants that are rare or localized, it may be hard to tell whether they are new arrivals or had just been overlooked before. We have had this question with, for example, *Conyza confusa*, *Glinus radiatus*, *Gnaphalium sphacilatum*, *Hibiscus pernambucensis*, and *Oplismenus hirtellus*.

In addition to plants brought in accidentally, several others have been planted intentionally. As part of a 1933 colonization study, scientists from the Mexican Escuela Nacional de Agricultura experimentally planted certain plants (Sánchez de la Peña 1948), but apparently none have survived. Two coconut palms (*Cocos nucifera* L.), probably planted later, grew well at Caleta Grayson (Mason & Hanna 14606); others have since been planted at Playa Blanca, where the introduction of *Hibiscus pernambucensis* may also have been intentional. The Mexican navy planted a grove of *Citrus aurantium* L. in the forest on the east slope of Cerro Evermann above the caldera valley (Moran 29529), and the trees produce heavily. Many food and ornamental plants grow near the naval base and at Huerta Grande. Four cultivated plants, *Acacia farnesiana*, *Cynodon dactylon*, *Lagenaria siceraria*, and *Solanum americanum*, and one possibly cultivated, *Chenopodium ambrosioides*, are already naturalized locally. Others, such as *Delonix regia* (Bojer) Raf., *Ipomoea fistulosa* Martius ex Choisy, *Psidium guajava* L., and *Terminalia catappa* L., may become naturalized on the island, as they have elsewhere in tropical America.

BOTANICAL COLLECTORS

Table 1 summarizes the work of all the botanists we know to have collected on Socorro. Johnston (1931) discussed those whose specimens he had seen, namely, C. H. Townsend, A. W. Anthony and A. L. Stockton,

²The date usually cited for the introduction of sheep is 1869 (Hanna 1925, Richards and Brattstrom 1959, Miranda 1960). This date is based on a report (quoted in Hanna 1925) prepared in 1923 by E. R. del Rip, a clerk in the American consulate in Manzanillo, Mexico. Though based on Mexican historical accounts, del Rip's report confuses information about Isla Socorro and other Mexican Islands, including Isla Guadalupe, and therefore may not be entirely reliable. An alternative date of between 1884 and 1887 derives from a letter (now in the University of Notre Dame library) dated 1 June 1887 from W. S. Lyon, an amateur botanist from California, to E. L. Greene. In it, Lyon stated that "some three years ago," i.e., in 1884, he was to have visited Socorro to evaluate the island's potential for sheep ranching. He did not make the trip for unspecified reasons, but reported that Californian sheep had since been introduced to the island. The possibility remains that Lyon and the men who had planned to send him to Socorro were unaware that sheep had been introduced in 1869.

TABLE 1. Plant collections from Isla Socorro.

Collector	Date	Collecting Localities ^a	Number of Specimens	Herbarium ^b
Charles H. Townsend	March 1889	BB	19	US
A. W. Anthony (Alfred L. Stockton)	May 1897	north and south ends	41 seen (of ?)	UC
Frederick E. Barkelew	May–July 1903	?; reached upper slopes	54 seen (of 68)	CAS†; UC, GH
Herbert L. Mason	May 1925	BB to CE; CB; CG	83	CAS
Octavio Solís	May 1925	with Mason	16 seen (of ?)	MEXU
Thomas Craig	February–March 1928	BB	few	POM
John Thomas Howell	March 1932	BA; CC; BB to 600 m	76	CAS
Jesús Patiño	1933	?, reached CE	20 seen (of ?)	MEXU
Francis H. Elmore	March 1939	BB	11	RSA (formerly AHFH and LAM)
H. L. Mason and G. Dallas Hanna	November 1953	BA; CB; CG	39	UC
James W. Warren	November 1953	with Mason and Hanna	9	LA
Sherwin Carlquist	May 1955	BA; CB to slopes of CE; CG	40	RSA
George Lindsay	February 1956	CC	14	SD
Reid Moran	March 1957	CB to CE to BA; CC; CG	224	SD
Faustino Miranda	January 1958	mostly S quarter of island, incl. CE	76	MEXU
Richard S. Felger	March 1967	CC to CE; PB	101	SD
Roberto Cruz ^c	March 1967	CC to CE; PB	80?	ENCB
Luz María Villarreal de Puga ^c	March 1967	CC to CE; PB	88	IBUG
Reid Moran	April 1978	BA; CC to 850 m; CG to 350 m; PB	114	SD
Reid Moran	April 1981	CC to CE; PB	60	SD
Geoffrey A. Levin	April 1987	BB; CG to CE	72	SD
Raymundo Domínguez	September–October 1988	CC to 600 m	65	CIB
José Luis León de la Luz	December 1988	CC to CE; PB	82	CIB
Geoffrey A. Levin	December 1988	CC to CE	28	SD

^aBA, Bahía Academy; BB, Bahía Braithwaite; CB, Caleta Binner; CC, Caleta Castelán; CE, Cerro Evermann; CG, Caleta Grayson; PB, Playa Blanca.

^bThe location of the first (or best) set of each collection is shown by the herbarium abbreviation from Holmgren *et al.* (1981).

^cSpecimens not seen for this study.

F. E. Barkelew, and H. L. Mason. Because of questions about the origin of some specimens, we review the itineraries of Anthony and Barkelew. Then we give a few notes about other collectors.

Anthony and Stockton

On the voyage of the *Wahlberg* in the spring of 1897, Alfred L. Stockton, a nephew of Katherine Brandegee, took charge of collecting plants (Brandegee 1899, 1900b). However, as with the voyage of 1896 when James M. Gaylord was botanist, the printed labels bear the name of A. W. Anthony, leader of the expedition. For simplicity, we follow the usual practice of citing the specimens as Anthony's.

The *Wahlberg* sailed from San Benedicto to the southwest coast of Socorro on 3 May, later anchored around the southern part of the island, moved to the north end about 14 May, and left for San Benedicto and Clarión on 16 May (Anthony n.d.). Most of Anthony's specimens have only inclusive dates for the whole trip. Some are unnumbered, but others, evidently collected in large sets, have completely printed labels with numbers at least from 180 to 435. Specimens

numbered 375–401 are labeled "Socorro," as are some unnumbered specimens. The numbers appear to be mainly chronological, since the sequence of label localities generally follows the itinerary of the trip. Some numbers are clearly out of chronological sequence, however. For example, no. 367 (*Eschscholzia ramosa* (E. Greene) E. Greene), from Isla Cedros, follows a series from San José del Cabo, although the *Wahlberg* did not return from San José to Cedros before sailing to the Revillagigedos. Thus it appears that the specimens were not numbered as collected and that the numbers therefore cannot be used to infer in what part of an island any specimen was collected, or even on which island. We see little reason to doubt the localities on any of Anthony's collections, however, except possibly for *Nicotiana stocktonii* (no. 382) and *Scaevola plumieri* (no. 387); see Remarks under those species in the catalogue.

Barkelew

From 14 May to 9 July 1903, Frederick E. Barkelew collected in the Islas Revillagigedo for the California Academy of Sciences. The first set of his collections

and any notes he might have made were destroyed in the San Francisco fire of 1906, but fortunately several sets of duplicates already were distributed. According to Johnston (1931:13), the most complete sets are at UC and GH (herbarium acronyms follow Holmgren et al. 1981). Partial sets are at A, ARIZ, DS, F, MO, NDG, NY, POM, and US (Cronquist 1945, Lanjouw and Stafleu 1954, Pfeifer 1970, Powell 1974). Johnston saw 66 numbered collections and we found three more, all numbered between 169 and 252.

Some evidence suggests that Barkelew numbered his specimens consecutively as he collected, and nothing suggests otherwise. For example, he gave consecutive numbers to three strand plants known in the Revillagigedos only from the north end of Socorro and likewise to eight plants known there only from the higher elevations. Similarly, some other plants of related habitats fall close together in the sequence.

Barkelew collected on San Benedicto, Socorro, and Clarión, in that order (Johnston 1931:13), but we have seen no labels for Clarión. The first eight numbers (169–176) are all labeled San Benedicto, and all but one are of species also collected there by others. All other specimens found are labeled Socorro, except no. 188, labeled San Benedicto. This is *Dodonaea viscosa*, not otherwise known from San Benedicto and not likely to have been overlooked on that barren island. Probably the specimen is from Socorro or Clarión, where this plant does occur, but was mislabeled, as Johnston (1931:14) suggested.

Number 218 is *Psilotum nudum*, not otherwise known from the Revillagigedos. With this single exception, numbers 177–244, so far as found, are all plants known to occur on Socorro, the second island Barkelew visited. Many, including 12 of the 13 specimens seen for numbers 227–244, are of species not known from San Benedicto or Clarión. Number 188 (*Dodonaea viscosa*) would therefore appear to be from Socorro.

The seven specimens seen for the last eight numbers (245–249, 252; 245 is a mixed collection of two *Ipomoea* species), though labeled Socorro, are of species known to occur on Clarión, the last island visited. Three of these specimens (245 and 246) are of species not known from Socorro; two more (247 and 248) are of *Melochia pyramidata* and *Macroptilium atropurpureum*, which were not otherwise found on Socorro until 1978 and 1988, respectively, and appear to be new arrivals there. None of the last eight numbers is of a species known from San Benedicto. Thus it appears that Barkelew's specimens numbered 245–252 really came from Clarión but were mislabeled, as Johnston (1931:14) suspected.

These specimens (245–252) include six of the seven species collected by Barkelew whose occurrence on Socorro Johnston (1931:14) doubted. Two of the

species, *Canavalia rosea* and *Cressa truxillensis*, have since been collected on Socorro; however, because the plants are also known from Clarión, Barkelew's specimens (249 and 252) probably came from Clarión, as his numbers suggest. The seventh species whose occurrence on Socorro Johnston doubted is *Caesalpinia bonduc*. Because that plant is now known to occur on Socorro as well as Clarión and because the number (207) falls among those presumably from Socorro, there now seems to be no reason to doubt the label locality. The rest of Johnston's doubtful species have yet to be collected in undisturbed habitats on Socorro.

In summary, we believe that Barkelew's numbers 245–252, though labeled Socorro, really came from Clarión; that his no. 188, labeled San Benedicto, really came from Socorro; and that his other collections are correctly labeled. We therefore exclude from the known native flora of Socorro the following species, whose only claim to inclusion rests on Barkelew's labels: *Ipomoea indica* (Burm. f.) Merr., *I. halierca* L. M. Johnston, *Macroptilium atropurpureum*, *Melochia pyramidata*, and *Sophora tomentosa* L.

Other Collectors

Octavio Solís was with H. L. Mason on the California Academy of Sciences expedition in 1925 (Hanna 1926), but Johnston did not see his collections. We found 16 of his specimens from Socorro (MEXU, US). Eight bear numbers, all between 20 and 90, suggesting that he collected many more, though not necessarily from Socorro. Most of the 16 have dates, altitudes, and brief habitat notes, but not specific localities. Some specimens bear labels of Gustavo A. Rovirosa, and at least one still has the name of Rovirosa as collector. The dates are those of Solís's visit, however, and Rovirosa was not on the trip.

Jesús Patiño's specimens have no specific localities or dates. One is labeled "500–900 meters," and two others (*Castilleja socorrensis* and *Gnaphalium attenuatum*) suggest that he reached the summit. Perhaps he was on the expedition of the Escuela Nacional de Agricultura (see Richards and Brattstrom 1959).

Because he was traveling with others, Richard S. Felger had little time for notes and numbered his specimens later, not chronologically. Moran curated the specimens, combining some collections, renumbering some because of duplicated numbers, and adding approximate coordinates. Thus some localities may be in error. On the same trip, Roberto Cruz collected about 80 numbers (J. Rzedowski, pers. comm.) and Luz María Villarreal de Puga (pers. comm.) collected 88; we have not seen their specimens, though de Puga sent us a list of her collections. In addition, some

faculty and students from the University of Guadalajara have made limited collections in recent years (L. M. V. de Puga, pers. comm.).

In 1988, biologists from the Centro de Investigaciones Biología (CIB), La Paz, Baja California Sur, began long-term studies on Isla Socorro. Two botanists, Raymundo Dominguez C. and José Luis León de la Luz, have collected on the island. Their studies and those by other CIB biologists may be expected to yield valuable collections in the future.

Though the number of specimens from Socorro has increased considerably since Johnston wrote his flora in 1931, most collections still are from near the few landing sites or from between the south shore and the peak of Cerro Evermann via the upper east slope. Large areas remain unexplored, especially on the north and east slopes. As on the nearby mainland (Mosiño Alemán and García 1974:375–376), almost all the rain on Socorro falls between July and October (see Climate, above). Most collections are from March to May—late in the dry season. Until 1988, when Dominguez, León, and Levin all collected between September and December, only Barkelew (May–July 1903) and

Mason and Hanna (November 1953) collected during or near the wet season. Thus opportunities for interesting collecting remain for the hardy botanist.

VEGETATION

Miranda (1960) described the vegetation of Isla Socorro and illustrated it with several excellent photographs. From his observations, mostly of the southwest to southeast slopes of the island, he classified the vegetation into seven types, mainly found in successive zones from shore to summit: coastal halophytes, *Croton* scrub, guava scrub, fig forest (with or without guavas), *Bumelia*/guava forest, *Dodonaea* scrub, and summit grassland. We propose no formal classification of the vegetation but discuss vegetation and species distribution under the following headings: shore, grassland, scrub, forest, and summit.

Shore.—*Ipomopsis pes-caprae brasiliensis* and *Jouvea pilosa* are common on sandy beaches around the island (Figure 2). These are joined by *Chamaesyce incerta* and *Heliotropium curassavicum* near the north end and by *Boerhavia coccinea*, *Physalis mimulus*, and invading



Fig. 2. Shore vegetation at Bahía Academy, with *Ipomoea pes-caprae* subsp. *brasiliensis* and *Jouvea pilosa* (lower right). The hillside in the background is dominated by *Conocarpus erecta* (dark trees) and *Croton masonii* (light shrubs).

Cenchrus echinatus at the south end. *Canavalia rosea* is locally common. At Playa Blanca, *Scaevola plumieri* is common on the outer beach (Caleta Trueno). Just back from the beach in the northern part of the island are thickets of *Conocarpus erecta* and groves of *Hippomane mancinella*. *Hibiscus pernambucensis* is invading and becoming common on and above the beach near Playa Blanca. *Cyperus ligularis* is locally common just behind the beach.

On bluffs and cliffs near the sea the vegetation is rather open. Common plants include *Nicotiana stocktonii* and *Perityle socorrensis*, both growing almost exclusively near the shore, and *Chamaesyce anthonyi*, *Cheilanthes peninsularis*, and *Erigeron socorrensis*, all reaching the summit.

Grassland.—In openings in the scrub near the coast on the southern part of the island, coarse grasses predominate, notably *Aristida vaginata*, *Cenchrus myosuroides*, *Heteropogon contortus*, and *Schizachyrium sanguineum*. Miranda (1960) suggested that some of these openings, particularly the large one at Cabo Rule, have resulted from the combined action of humans and sheep. Small grassy flats occur well beyond their influence, however, as in the scrub just south of Caleta Grayson. A large area on the southeast side of the island, north of Huerta Grande at 300–450 m, clearly denuded by sheep, supports not perennial grasses but annual grasses and forbs.

Over much of the comparatively dry west slope of the island above Caleta Grayson, grasses (especially *Schizachyrium sanguineum*) predominate on slopes and ridges, whereas scrub and small trees of *Ficus cotinifolia* predominate in moister places such as arroyos and north-facing slopes.

Scrub.—A fairly dense non-spiny scrub, generally about 1–2 m high, covers most of the island (Figures 3 and 4). Although it varies from place to place, several very widespread plants tend to give it a basic uniformity in most places. *Chamaesyce anthonyi* and *Waltheria indica* are common from shore to summit and often abundant; with them, usually in lesser numbers, are *Acalypha umbrosa*, *Brickellia peninsularis*, *amphithalassa*, *Dodonaea viscosa*, *Triumfetta socorrensis*, and *Viguiera chenopodina*. On the generally moister north slope of the island, *Erigeron socorrensis* and *Spermacoce nesiotica* also are abundant, and *Pteridium caudatum*, *Schizachyrium sanguineum*, and *Sorghastrum nutans* are common.

At low elevations on the south and east sides of the island, *Croton masonii* predominates, sometimes to the near exclusion of other plants, giving the scrub a grayish cast (Figure 3). On the lower north and west slopes it is also common, sometimes forming pure stands locally but generally sharing the dominance with *Chamaesyce anthonyi*, *Dodonaea viscosa*, *Spermacoce nesiotica*, and *Waltheria indica*.



Fig. 3. Scrub northeast of Caleta Binner, composed almost exclusively of *Croton masonii*.



Fig. 4. Lava flow on south side of Cerro Evermann at ca. 700 m. Dominant plants are *Dodonaea viscosa* (dark) and *Lepechinia hastata* subsp. *socorrensis* (light).

Dodonaea viscosa, though common elsewhere as well, predominates in dry rocky places such as talus slopes and lava flows (Figure 4), where some of its usual associates are lacking. Often with it in such places are *Cordia curassavica* and *Lepechinia hastata socorrensis*.

Forest.—Fairly dense forest covers much of the wet middle east slope of the island (Figures 5 and 6) and extends to the canyons and shallow valleys to the north. Dominant trees are *Bumelia socorrensis*, *Ficus cotinifolia* (Figure 7), and *Ilex socorroensis*. Also common are *Guettarda insularis* and *Psidium* sp.; less common are *Meliosma nesites*, *Prunus serotina*, and, at higher elevations, *Oreopanax xalapense*. On both trees and ground are the ferns *Asplenium sessilifolium*, *Polypodium alfredii*, and *P. polypodioides aciculare*; other epiphytes include *Peperomia socorronis*, *P. tetraphylla*, and various orchids. Lianas are uncommon but include *Chiococca alba* and *Vernonia littoralis*.

Southward, at lower elevations, the forest becomes lower and more open, reduced to shrubby *Ficus cotinifolia* and *Psidium* sp. or, in places, to *Psidium* alone. In this area, roamed by the sheep, there is little herbaceous vegetation, and the shrubs look in poor condition.

Bumelia socorrensis, *Guettarda insularis*, and *Ilex socorroensis* extend as shrubs nearly to the summit of Cerro Evermann; shrubby *Guettarda* also extends to sea level. Tree-size *Ficus cotinifolia* reaches the north coast at Bahía Academy and Playa Blanca and even approaches the shore in the narrow arroyo just north of Caleta Binner.

Summit.—The summit of Cerro Evermann is cooler and wetter because of the elevation and the cloud cap that often covers it. About the summit, above about 950 m and down the west slope, coarse grasses predominate, especially *Aristida vaginata*, *Schizachyrium sanguineum*, *Setaria geniculata*, and *Sorghastrum nutans* (Figure 8). Although the predominance of grasses might result from grazing sheep, Levin found exposed ridgetops north and west of the summit equally grassy but apparently not reached by the sheep. Patches of brush extend up the east slope, with a few shrubs and subshrubs reaching the summit, including *Bidens socorrensis*, *Brickellia peninsularis amphithalassa*, *Bumelia socorrensis*, *Chamaesyce anthonyi*, *Dodonaea viscosa*, *Eupatorium pacificum*, *Guettarda insularis*, *Hypericum eastwoodianum*, *Ilex socorrensis*, *Lepechinia hastata socorrensis*, *Spermacoce*



Fig. 5. Forest on southeast side of Cerro Evermann at ca. 800 m.

nesiotica, *Triumfetta socorrensis*, and *Waltheria indica*. These are also found in the forest or scrub below. Many herbs are found only on the small climatic island of the peak, mainly in grassy places on the east slope, though others extend lower, some even to sea level. Plants found only near the summit include *Aegopogon solisii*, *Botrychium socorrense*, *Castilleja socorrensis*, *Centaurium capense*, *C. wigginsii*, *Conyza confusa*, *Daucus montanus*, *Gnaphalium attenuatum*, *G. sphacilatum*, *Hibiscus diversifolius*, *Linaria canadensis texana*, *Oplismenus hirtellus*, *Passiflora* sp., *Sporobolus purpurascens*, and *Triodanis perfoliata biflora*. This combination of local and widespread species makes the summit vegetation particularly rich, containing about one-third of the species native to the island.

BIOGEOGRAPHY

The known native vascular flora of Isla Socorro now stands at 117 species (Tables 2, 3, and 4). Four of these are identified only to genus, mostly for lack of adequate material: *Opuntia* sp., *Passiflora* sp., *Psidium* sp., and *Rubus* sp. Of the 113 identified species, 30 (26.5%) are endemic to Socorro at the specific (27) or subspecific (3) level. Nine more (8%) are endemic to

the Revillagigedos (7 specific, 2 subspecific). The rate of endemism for the Revillagigedos is 31.6% (43/136; see Appendices 1 and 2).

Although 26.5% may seem a high rate of endemism, for oceanic islands other than atolls it is only moderate. Carlquist (1974:112) found a range of 12–94% for 11 diverse oceanic islands. Furthermore, the Socorro flora does not show adaptive radiation. As a measure of insular diversity, several authors (MacArthur and Wilson 1967, Simberloff 1970) have used the species/genus ratio. Balgooy (1969) preferred the genera/family ratio, and Carlquist (1974:110–116) used both and added the species/family ratio. Table 2 summarizes vascular plant diversity on Isla Socorro. For Socorro the species/genus ratio is 1.15 for all species and 1.23 for endemics. Only one genus (*Cyperus*) has more than three species native to the island, and only in that genus, and perhaps in *Psidium*, are different species on the island closely related. In almost all genera with more than one species on the island, the species belong to different sections or subgenera. For Socorro the genera/family ratio is 2.17 and the species/family ratio is 2.49. Each of the three values for Socorro is near the lowest of those Carlquist (1974:112) calculated for 11 oceanic islands and is well below what he considered the threshold for radiation.



Fig. 6. Forest on upper east slope of Cerro Evermann. Fern is *Asplenium sessilifolium*.

Several factors explain the moderate level of endemism on Socorro and the Revillagigedos. First, Socorro is a relatively small island with little ecological diversity to promote radiation (MacArthur and Wilson 1967:173-174, Balgooy 1969, Carlquist 1974:92-100). Second, unlike island groups known for their high endemism, such as the Hawaiian Islands and the Galápagos, the Revillagigedos are not an extensive archipelago that might allow speciation on different islands followed by dispersal among the islands (MacArthur and Wilson 1967:175). Only three genera (*Aristida*, *Aristolochia*, and *Erigeron*) are represented by sister species on different islands. Third, Socorro is closer to the mainland than are most oceanic islands,

so that dispersal to the island is likely to be more frequent, reducing the probability of speciation (MacArthur and Wilson 1967:175). Thus, as would be expected on a small, solitary oceanic island relatively near the mainland, a moderate number of new island species has evolved but no radiation has occurred.

Sources of the Flora

Table 3 summarizes the distribution off the island of each non-endemic species, and Table 4 summarizes the distribution of the putative closest relative of each endemic species. Table 5, which summarizes Tables 3 and 4, is an analysis of the geographic relationships of the flora. (For the purposes of this discussion we

TABLE 2. Vascular plant diversity on Isla Socorro.

	Families		Genera		Species	
	Native	Introduced	Native	Introduced	Native	Introduced
Ferns and fern allies	3	0	8	0	10	0
Dicotyledons	40	7	77	24	86	37
Monocotyledons	4	0	17	5	21	10
All vascular plants	47	7	102	29	117	47
Total		54		131		164



Fig. 7. *Ficus cotinifolia*.



Fig. 8. Summit of Cerro Evermann, with vegetation of coarse grasses and scattered low shrubs.

TABLE 3. Distributions and presumed modes of dispersal for non-endemic native plants of Isla Socorro.

Non-endemic Species	Distribution beyond Socorro ^a					Dispersal ^b
	Western Mexico	Baja California	West Indies	Other	Widespread in Amer. Tropics	
<i>Abutilon californicum</i>	N	X				D?
<i>Adiantopsis radiata</i>	S		X		X	A
<i>Aristida adscensionis</i>	W	X	X		X	BB
<i>Asplenium formosum</i>	W		X		X	A
<i>Asplenium sessilifolium</i>	N					A
<i>Boerhavia coccinea</i>	W	X	X		X	BV
<i>Bursera epinnata</i>		X				BI
<i>Caesalpinia bonduc</i>	W		X		X	D
<i>Canavalia rosea</i>	W		X		X	D
<i>Cardiospermum halicacabum</i>	W	X	X		X	D
<i>Cattleya aurantiaca</i>	W					A
<i>Cenchrus myosuroides</i>	W		X		X	BB
<i>Centaurium capense</i>		X				BM
<i>Centaurium wigginsii</i>	N					BM
<i>Chamaesyce incerta</i>	N	X				D?
<i>Chiococca alba</i>	W	X	X		X	BI
<i>Conocarpus erecta</i>	W	X	X		X	D
<i>Conyza confusa</i>	W					BB
<i>Cordia curassavica</i>	W	X	X		X	BI
<i>Cressa truxillensis</i>	W	X			X	D
<i>Cynanchum californicum</i>		X				BB
<i>Cynanchum sonorensis</i>	N					BB
<i>Cyperus howellii</i>	N					BM
<i>Cyperus ligularis</i>	W	X	X		X	BM
<i>Daucus montanus</i>	W				X	BB
<i>Dodonaea viscosa</i>	W	X	X		X	D
<i>Elytraria imbricata</i>	W	X			X	BV?
<i>Epidendrum nitens</i>	S					A
<i>Epidendrum rigidum</i>	S		X			A
<i>Ficus cotinifolia</i>	W					BI
<i>Forestiera rhamnifolia</i>			X	E Mexico		BI
<i>Galium mexicanum</i>	W					BB
<i>Glinus radiatus</i>	W	X	X		X	BM
<i>Gnaphalium attenuatum</i>	W					BB
<i>Gnaphalium sphacilatum</i>	W	X				BB
<i>Gossypium hirsutum</i>			X	Pacific Islands		D
<i>Heliotropium curassavicum</i>	W	X	X		X	D
<i>Heteropogon contortus</i>	W	X	X		X	BM
<i>Heterotoma cordifolia</i>	W					BM
<i>Hibiscus diversifolius</i>			X	C. & S. Am.		D?
<i>Hippomane mancinella</i>	S		X		X	D
<i>Ipomoea pes-caprae brasiliensis</i>	W	X	X		X	D
<i>Ipomoea triloba</i>	W	X	X		X	D
<i>Jouvea pilosa</i>	W	X				D
<i>Lantana velutina</i>	W	X				BI
<i>Linaria canadensis texana</i>	W	X				BM?
<i>Oplismenus hirtellus</i>	N	X	X		X	BB
<i>Opuntia</i> sp.						BI
<i>Oreopanax xalapense</i>	W				X	BI
<i>Passiflora</i> sp.						BI
<i>Pavonia hastata</i>				S. Am., SE U.S., NE Mexico		D?
<i>Peperomia tetraphylla</i>	W		X		X	BV
<i>Phaseolus lunatus</i>	W				X	D?
<i>Phoradendron commutatum</i>	W					BI
<i>Polypodium alfredii</i>	S					A
<i>Polypodium polypodioides aciculare</i>	W					A
<i>Polystichum muricatum</i>	S		X		X	A
<i>Portulaca pilosa</i>	W	X	X		X	D

TABLE 3 (continued)

Non-endemic Species	Distribution beyond Socorro ^a					
	Western Mexico	Baja California	West Indies	Other	Widespread in Amer. Tropics	Dispersal ^b
<i>Potamogeton nodosus</i>	W		X		X	BI
<i>Prunus serotina</i>	W					BI
<i>Psidium</i> sp.						BI
<i>Psilotum nudum</i>	W		X		X	A
<i>Pteridium caudatum</i>	W		X		X	A
<i>Rhamnus sharpii</i>	S					BI
<i>Rhynchosia minima</i>	W	X			X	D?
<i>Rubus</i> sp.						BI
<i>Scaevola plumieri</i>	W	X	X		X	D
<i>Schizachyrium sanguineum</i>	W	X	X		X	BB
<i>Setaria geniculata</i>	W	X	X		X	BB
<i>Sida rhombifolia</i>	W	X	X		X	D?
<i>Solanum madrense</i>	W					BI
<i>Sorghastrum nutans</i>	W					BB
<i>Sporobolus purpurascens</i>	S		X			BI
<i>Tournefortia hartwegiana</i>	W	X				BI
<i>Triodanis perfoliata biflora</i>	W	X			X	BM
<i>Uiguiera chenopodina</i>		X				BB
<i>Waltheria indica</i>	W	X	X		X	D?
<i>Zanthoxylum insulare</i>	N		X			BI

^aWe give distributions outside the primary source areas of western mainland Mexico, Baja California, and the West Indies only if the species does not occur in either western mainland Mexico or Baja California. We divide western mainland Mexico into two subregions: northwestern (N) for the coastal states from Colima north and southwestern (S) for the coastal states south of Colima; if a species occurs in both regions, we show "W" for western. Other geographic abbreviations: C. Am., Central America; E, eastern; NE, northeastern; S, southern; S. Am., South America; SE, southeastern.

^bA, air flotation; BB, barbs, bristles, etc., caught on birds; BI, internally in birds; BM, mud on birds' feet; BV, viscid disseminules stuck to birds; D, drift.

include under the term "endemic" both plants restricted to Socorro and other Socorro plants endemic to the Revillagigedos.) Among potential source areas we include not only Baja California and western mainland Mexico, the closest land masses, but also the West Indies because Johnston (1931) thought the Socorro flora bore some relationship to the West Indian.

Table 5 clearly shows that the Socorro flora is mainly west Mexican. Fully 83% of the species occur also in western mainland Mexico or (endemics) have their closest relatives there, and 25% extend no farther. The Socorro flora is less related to the Baja Californian. Fewer than half the species (47%) occur also in Baja California or (endemics) have their closest relatives there, and very few (11%) extend no farther. Nearly half the Socorro species (46%) occur also in the West Indies or (endemics) have their closest relatives there, but all these plants extend beyond the West Indies, most to western or southwestern Mexico. (Johnston (1931) suggested that the closest relatives of two endemics, *Ilex socorroensis* and *Pleurothallis unguicallosa*, are

restricted to the West Indies, but we consider the relationships of these species unclear.) Thus the relationship with the West Indian flora is not remarkable.

Because Socorro is closer to Baja California than to mainland Mexico, the much stronger affinity of the flora with that of western Mexico may appear surprising. Mainland Mexico, however, is a much larger and more diverse source for colonization than is tropical Baja California. Furthermore, the principal storm tracks run from the east or southeast (Mears 1944:104, Mosiño Alemán and García 1974:359–360), probably favoring dispersal of all but drift plants, which are favored by the current from the north. Finally, because the flora of southern Baja California shares many species with the mainland flora (Brandeggee 1892, Wiggins 1960), the specific source for these species is not identifiable.

Though both non-endemics and closest relatives of endemics are basically Mexican, the distributions of the two groups show some interesting differences (Table 5). Proportionally, many more of the non-

TABLE 4. Distribution and presumed modes of dispersal for endemic plants of Isla Socorro and their closest relatives. (We also include here Socorro plants endemic to the Revillagigedos.)

Endemic Species	Distribution in Revillagigedos ^b	Distribution of Closest Relative ^a					Widespread in Amer. Tropics	Dispersal ^c
		Western Mexico	Baja California	West Indies	Other			
<i>Acalypha umbrosa</i>	E		X					BM?
<i>Aegopogon solisii</i>	E	W	X					BB
<i>Aristida vaginata</i>	E	N						BB
<i>Aristolochia socorroensis</i>	E	W	X					BI?
<i>Bidens socorrensis</i>	E	W		X				BB
<i>Botrychium socorrense</i>	E	W						A
<i>Brickellia peninsularis amphithalassa</i>	C		X					BB
<i>Bulbostylis nesiotica</i>	R	W		X				BM
<i>Bumelia socorrensis</i>	E	W	X	X			X	BI
<i>Castilleja socorrensis</i>	E		X					BM?
<i>Cestrum pacificum</i>	E	W						BI
<i>Chamaesyce anthonyi</i>	R	W	X	X			X	BI?
<i>Cheilanthes peninsularis insularis</i>	C		X					A
<i>Coreocarpus insularis</i>	E		X					BB
<i>Croton masonii</i>	E	N						D?
<i>Cyperus duripes</i>	R	W	X	X			X	BM
<i>Erigeron socorrensis</i>	E	W						BB
<i>Eupatorium pacificum</i>	E	W						BB
<i>Guettarda insularis</i>	E	W		X				BI
<i>Hypericum eastwoodianum</i>	E		X					BM?
<i>Ilex socorroensis</i>	E				?			BI
<i>Lantana involucrata socorrensis</i>	E			X	SE Mexico, C. & S. Am.			BI
<i>Lepechinia hastata socorrensis</i>	E		X					BV?
<i>Meliosma nesites</i>	E	W						BI
<i>Nicotiana stocktonii</i>	C				NE Mexico C. & S. Am.			BM?
<i>Paspalum longum</i>	E			X				BI
<i>Peperomia socorronis</i>	E	W						BV
<i>Perityle socorrensis</i>	R		X					BB
<i>Physalis mimulus</i>	E	W	X	X			X	BI
<i>Pleurothallis unguicallosa</i>	E				?			A
<i>Psidium socorrense</i>	E				?			BI
<i>Salvia pseudomisella</i>	E	W	X	X			X	BV?
<i>Sida nesogena</i>	E	W	X	X			X	D?
<i>Spermacoce nesiotica</i>	C	W		X				BM?
<i>Teucrium townsendii affine</i>	E	N		X				BM
<i>Triumfetta socorrensis</i>	E	W						BB
<i>Verbena sphaerocarpa</i>	E	W						BI?
<i>Vernonia littoralis</i>	E	W						BB
<i>Zapoteca formosa socorrensis</i>	C	W	X					D?

^a C, also on Clarión; E, only on Socorro; R, on all the Revillagigedos.^b We give distributions outside the primary source areas of western mainland Mexico, Baja California and the West Indies only if the endemic species does not have closest relatives in either western mainland Mexico or Baja California. Abbreviations as in Table 3.^c Abbreviations as in Table 3.

endemics are widely distributed in the American tropics. Indeed, plants that disperse so well would be expected to colonize the island repeatedly and so not to speciate there (MacArthur and Wilson 1967:175). Only 5% of the non-endemics are restricted to Socorro and Baja California, whereas fully 22% of the relatives of endemics are found only in Baja California. Restriction to Baja California may result from limited dispersal ability, so that these plants would be unlikely

to reach the island more than once and therefore more likely to speciate should they colonize it. Furthermore, Table 5 suggests that dispersal to Socorro generally is less likely from Baja California than from mainland Mexico—again with the result that plants from Baja California are more likely to speciate on the island. Similar causes may explain why just 5% of the non-endemics grow in neither Baja California nor western mainland Mexico but only in some more distant area

TABLE 5. Geographic relationships of flora of Isla Socorro. We base percentages on the 74 identified non-endemics and on the 36 endemics for which we can identify closest relatives. Data for individual species can be found in the Catalogue of Species and are summarized in Tables 3 and 4.

	Western Mainland Mexico		Baja California		West Indies		Not in Western Mexico or Baja California	Widespread in American Tropics
	Present	Restricted	Present	Restricted	Present	Restricted		
Non-endemics (74 spp.)	66 89%	17 23%	35 47%	4 5%	37 50%	0 0%	4 5%	38 51%
Closest relatives of endemics (36 spp.)	25 69%	11 30%	17 47%	8 22%	14 39%	0 0%	3 8%	6 17%
Total (110 spp.)	91 83%	28 25%	52 47%	12 11%	51 46%	0 0%	7 6%	44 40%

whereas 8% of the closest relatives of endemics grow only in a more distant area. Johnston (1931) considered an even higher proportion of endemics to be derived from outside western Mexico and Baja California; our lower figure probably results from increased knowledge of plant distribution in Mexico and from refinements in taxonomy.

Modes of Long-Distance Dispersal to Socorro

Using the guidelines proposed by Carlquist (1974:54–82), we have decided what mode of long-distance dispersal seems most probable (or least improbable) for the ancestor of each plant taxon native to Socorro (Tables 3 and 4). Of the 117 species, 14 (12%) probably arrived by air flotation, 24 (21%) by barbs, bristles, etc., caught on birds, 31 (26%) internally in birds, 17 (15%) in mud on birds' feet, 6 (5%) by viscid disseminules stuck to birds, and 25 (21%) by drift, either rare or frequent. These figures are mostly close to those Carlquist (1974:78) determined for the Revillagigedos using Johnston's (1931) flora. Our figure for air flotation is higher, however, probably because of the several newly reported ferns and orchids. Also, our figure for drift is lower and our figure for mud on birds' feet is higher. We guessed that many plants with small seeds and no obvious means of long-distance dispersal might have reached Socorro in mud on birds' feet, whereas Carlquist perhaps guessed drift instead. These two modes are the least distinctive, so we do not place much confidence in these figures. For the oceanic islands he studied, Carlquist (1974:78–82) interpreted high frequencies of air-borne and of barbed disseminules as reflecting (1) relative closeness of the island to the mainland and (2) a relatively dry climate, which favors plants with these types of disseminules over plants with fleshy fruits eaten by birds. On Socorro, most of the plants with fleshy fruits grow in the forest or wetter scrub.

We also summarize means of arrival for the closest relatives of the 39 endemic species alone: 3 (8%) by

air flotation, 10 (26%) by barbs, etc., caught on birds, 12 (31%) internally in birds, 8 (20%) in mud on birds' feet, 3 (8%) by viscid disseminules, and 3 (8%) by drift. The substantial decreases for air flotation and especially for drift may reflect the efficacy of these methods for dispersal to Socorro and the resultant reduced probability that plants arriving by these means will differentiate into new species. The increases for all types of dispersal by birds probably are simply the consequence of decreases for the other two types.

The preponderance of dispersal by birds to Socorro is striking, both for the entire flora (67%) and for the endemics (85%). Jehl and Parkes (1982), documenting the avifauna of the Revillagigedos, listed six shorebirds, five gulls, and five warblers that are at least casual visitors to Socorro, and Levin has observed one more (Wandering Tattler, *Heteroscelus incanus*). In addition, Mourning Doves (*Zenaida macroura*) and Northern Mockingbirds (*Mimus polyglottos*) have recently colonized the island (Jehl and Parkes 1982, 1983). Thus there appear to be enough birds visiting the island to account for their importance as dispersal agents.

Evolution of the Flora

Many of the non-endemic species on Isla Socorro differ from their mainland representatives in subtle ways, as might be expected from the isolation of the island populations. Though many of the differences, as well as the differences between the endemics and their closest relatives, appear to be random, certain patterns do emerge. Most notable is increased woodiness. The perennial endemics *Bidens socorrensis*, *Chamaesyce anthonyi*, *Erigeron socorrensis*, and *Salvia pseudomisella* all appear to be derived from herbaceous annual ancestors, and both *C. anthonyi* and *E. socorrensis* are well-developed shrubs. *Hypericum eastwoodianum* and *Perityle socorrensis* are also endemics that are shrub-brier than their mainland relatives, though those are perennial. Among non-endemics, only *Conyza confusa* appears to have become more woody on the island.

Carlquist (1974:350–428) discussed insular woodiness at length. Among the possible causes he discussed, climatic moderation seems the most likely to apply on Socorro.

Certain species among both endemics (*Brickellia peninsularis amphithalassa*, *Lepechinia hastata socorrensis*, *Sida nesogena*) and non-endemics (*Abutilon californicum*, *Conyza confusa*, *Waltheria indica*) have

denser and/or longer pubescence than their mainland relatives. The reason for this is not obvious, but perhaps greater pubescence helps protect the leaves from intense sunlight or winds. Possibly winds also account for the inflorescences of *A. californicum*, *S. nesogena*, *Verbena sphaerocarpa*, and *W. indica* being more compact than those of their mainland relatives.

CATALOGUE OF SPECIES

This list includes all species of vascular plants known to be native or naturalized on Isla Socorro. An asterisk before the name means that the plant probably is not native. A list of species reported from Socorro but excluded from our flora follows the list of known species.

Lists of synonyms are not necessarily complete but aim to include all names used for the taxa as they occur on Socorro. We summarize the known distribution on the island for each taxon, the distribution off the island for each non-endemic taxon, and the distribution of the putative closest relative for each endemic. We generally cite specimens only if the species is newly reported. We add brief descriptive and taxonomic notes as appropriate. Our descriptions of abundance are based on subjective impressions and are not quantifiable.

FERNS AND FERN ALLIES

Key to Families

1. Leaves scale-like; stems naked, dichotomously branched; sporangia trilocularPSILOACEAE
1. Leaves foliaceous; stems clothed with scales and/or leaf bases, variously branched; sporangia unilocular
 2. Stipes two-branched below the blade, one portion fertile with sporangia borne on an erect non-leafy panicle (only a stub remaining on old leaves), the other portion sterile and leaf-likeOPHIOGLOSSACEAE
 2. Stipes not branched below the blade; sporangia borne on the undersides of normal leavesPOLYPODIACEAE *sensu lato*

Ophioglossaceae

***Botrychium socorrense* W. Wagner, sp. nov. (Figure 9)**

Type.—Isla Socorro, Mexico: uncommon in summit grassland at ca. 1000 m, slope ca. 1 km northwest of summit of Cerro Evermann, near 18°47'N, 110°58'W, 15 December 1988, *Levin 2044* (Holotype: SD 124655; isotypes BM, MEXU, MICH, MO, UC, US).

Planta 40–60 cm alta. Caulis erectus, usque ad 1 cm diametro. Primordia foliorum dense sericea pilis 5 mm longis. Radices usque ad 15, suberosae annulataeque. Lamina sterilis 4-pinnata, late deltoidea, 16 (13–20) cm longa, 25 (17–28) cm lata; segmenta arcuata imbricata; pinnulae ultimae pro parte maxima ovatae vel late lanceolatae, vadosae vel profunde fissae, illae non ad medium fissae 10.5 (7–14) mm longae, 5.5 mm latae, margine crenulatae. Sporophorum 40–60 cm altum, fasciculo sporangiorum ca. 10–15

cm longo. Typus: *Levin 2044* (SD 124655). Species *B. schaffneri* affinis sed statura majore, pinnis pinnulisque arcuatis imbricatis, et segmentis ovatis vel late lanceolatis differt.

Coarse fleshy perennial herb, 40–60 cm tall when mature, including the fertile structure (sporophore). Stem erect, up to 1 cm in diameter, covered by root and leaf bases. Roots up to 15 per plant, corky with closely spaced encircling ridges, and reaching to 5 mm in diameter (dried specimens). Leaf primordia densely covered with fine silky hairs up to 5 mm long, and enclosed by tubular leaf sheath. Leaf sterile by abortion of sporophore, or two-parted, with sterile photosynthetic portion (trophophore) more or less horizontal when alive, and an erect sporophore. Common stalk in mature leaves 4.5 (3–8) cm long. Trophophore stalk 15 (10–26) cm long, very robust, 5.5 (4–8) mm in diameter (dried). Trophophore blade broadly deltoid, 16 (13–20) cm long, 25 (17–28) cm wide, tetrapinnate. Pinnae alternate to opposite, the tips somewhat rounded. Pinnules that are cleft less than one-half the distance to main vein 10.5 (7–14) mm long, 5.5 (4–7) mm wide. Pinnule margins shallowly crenate, the crenations associated with vein endings. Sporophore stalk considerably larger than entire trophophore, 32 (25–42) cm long, topped by a sporangial cluster 10–15 cm long (as estimated from fragmentary axes).

Paratypes.—Uncommon in grassland, ridge northwest of Cerro Evermann, 915 m, *Levin 1814* (MICH, SD); north slope of Cerro Evermann near solfataras, 1000 m, *Moran 5854* (SD); north ridge of Cerro Evermann, 950 m, *Moran 5854A* (SD).

Distribution.—Endemic to Isla Socorro. Uncommon, in sparse grass and under brush, north and west slopes of Cerro Evermann above about 900 m.

Relationships.—*B. socorrense* is most closely related to *B. schaffneri* L. Underw. of the mainland Mexican highlands. The Socorro plant differs in its extremely robust habit (40–60 cm tall rather than mostly 15–35 cm tall), its broadly ovate to lanceolate, relatively undivided, and roundish tipped leaf segments (rather than lanceolate to linear and more divided and pointed), and its more coarsely crenate leaf margins (rather than mostly entire to finely crenate). The

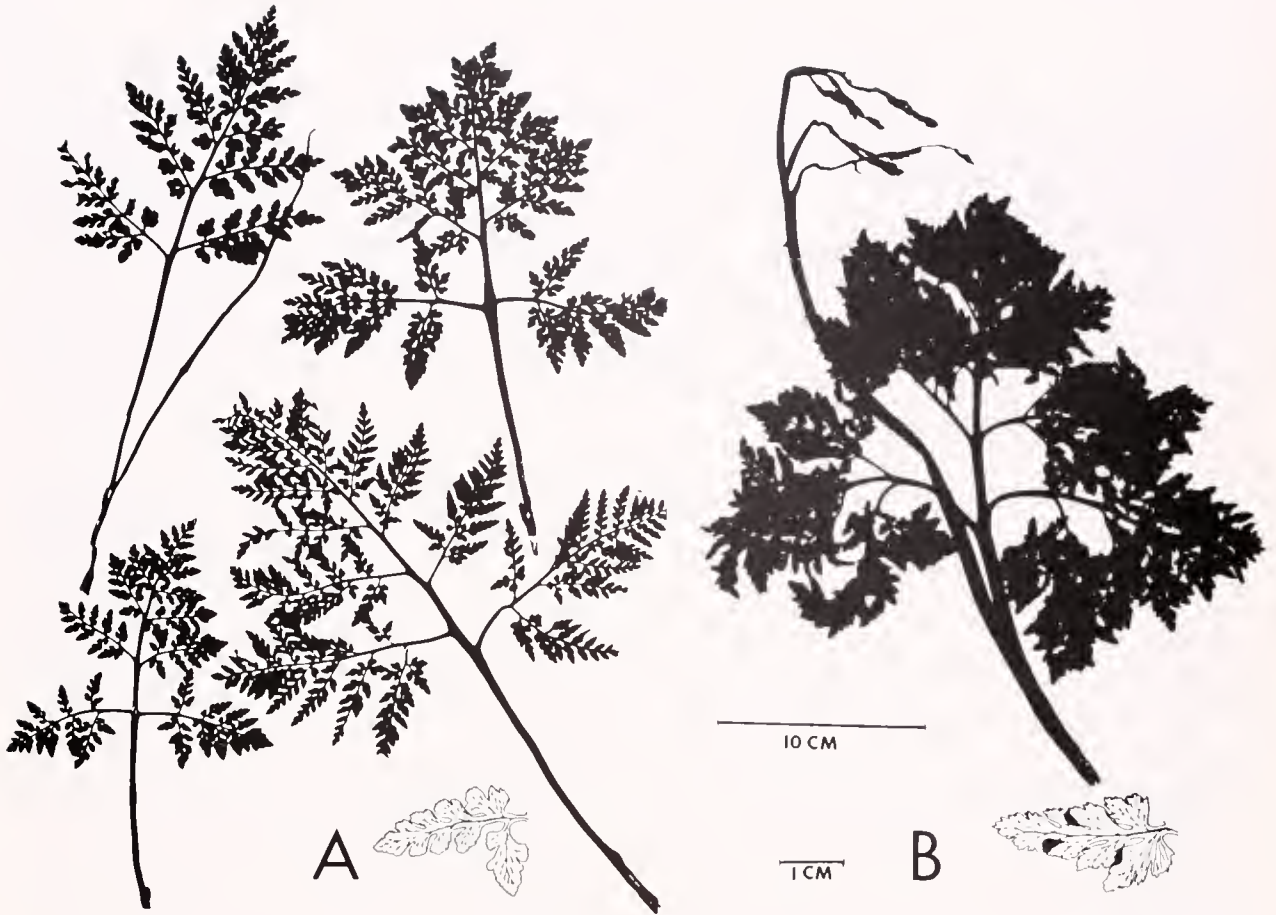


Fig. 9. Leaves and pinnae of *Botrychium*. A, *B. schaffneri* (Mexico, Guerrero, 6.5 miles from Tetipac on road to Taxco, *Wagner and Wagner 80821*; MICH); B, *B. socorrense* (*Levin 2044*; SD).

strongly overlapping blade divisions are especially distinctive. Figure 9 illustrates these differences, which are also maintained in immature plants, of which we have examined three examples of *B. socorrense* (*Moran 5854*). Extremely fine cutting like that frequently seen in *B. schaffneri* has not been documented for *B. socorrense*. Perhaps environmental factors have played a role in the distinctive morphology of *B. socorrense*. Its habitat, among tall grasses, is similar to that of *B.*

schaffneri, but at a considerably lower altitude (only 915–1000 m vs. 1650–3000 m, average 2500 m, for *B. schaffneri*). The climate of Isla Socorro is oceanic, however, and the frequent cloud cover near the summit may ameliorate the effects of the lower elevation. The Socorro grapefern should be further studied biosystematically, by means of common garden experiments as well as isozyme analysis.

Polypodiaceae

Key to Species

1. Blades digitate, with several pinnae arising from the same point *Adiantopsis radiata*
1. Blades pinnate or bipinnate, the pinnae arising from many points along the rachis
 2. Blades once pinnate, the pinnae entire
 3. Pinnae essentially glabrous *Polypodium alfredii*
 3. Pinnae densely scaly on undersurfaces *Polypodium polypodioides*
 2. Blades twice or more pinnate, or if once pinnate then the pinnae toothed to lobed
 4. Fronds large, 1.2–3 m tall; blades coriaceous; sori continuous, marginal, covered by inrolled leaf margin *Pteridium caudatum*
 4. Fronds smaller, much less than 1 m tall; blades generally thinner; sori marginal or on undersurface of blade
 5. Leaf segments essentially equilateral, equally divided along both sides; sori marginal to submarginal, covered by the inrolled leaf margin *Cheilanthes peninsularis*
 5. Leaf segments clearly inequilateral, much more deeply divided on the upper side than on the lower side; sori on undersurface of blade, covered by indusium arising from blade surface
 6. Pinnae with spinose teeth; sori round; indusia peltate *Polystichum muricatum*
 6. Pinnae toothed, but the teeth not spinose; sori elongate; indusia attached along one side
 7. Stipes dull; upper side of ultimate leaf segments with a basal lobe cut nearly to midrib; plantlets often produced near leaf apex *Asplenium sessilifolium*
 7. Stipes lustrous; upper side of ultimate leaf segments equally incised along entire length but not lobed at base; plantlets not produced *Asplenium formosum*

Adiantopsis radiata (L.) Fée, Mém. Foug. 5:145. 1852.

Distribution.—Occasional in rock crevices and on damp forest floor, 550–800 m. Southern and eastern Mexico, West Indies, to South America.

Asplenium formosum Willd., Sp. Pl. 5:329. 1810.

Distribution.—Occasional on canyon walls and on tree trunks and forest floor, from near shore to near summit. Southern and western Mexico, West Indies, to South America.

Remarks.—On the basis of *Mason 1615* and *1631*, Weatherby (in Johnston 1931:48) said the Socorro plant differed from the typical form in its brown rachis and rather less divided pinnae, in these respects approaching *A. carolinum* Maxon [*A. formosum* var. *carolinum* (Maxon) C. Morton], of the Galápagos Islands.

Asplenium sessilifolium Desvaux, Berlin. Mag. 5:322. 1811.

A. potosinum Hieron. var. *incisum* Hieron., Hedwigia 60:247. 1918.

Distribution.—Common in forest shade, at least 700–825 m. Central and western Mexico to South America.

Remarks.—We follow Mickel and Beitel (1988) in treating *A. potosinum incisum*, the name used by Johnston (1931:49), as a synonym of *A. sessilifolium*.

Cheilanthes peninsularis Maxon var. *insularis* Weath., Amer. Fern J. 21:25. 1931.

Distribution.—Fairly common on rocks and cliffs, especially near shore but also to summit. Endemic to islas Clarión and Socorro; type from very dry north-facing wall of canyon above Caleta Grayson, 300 m, 4 May 1925, *Mason 1616* (CAS 186601).

Remarks.—The var. *peninsularis* is endemic to

central and southern Baja California. In the protologue of var. *insularis*, Weatherby described specimens from Comondú as intermediate, some individuals rather closely approaching var. *insularis*.

Polypodium alfredii Rosenstock, Repert. Spec. Nov. Regni Veg. 22:15. 1925. *Pecluma alfredii* (Rosenstock) Price, Amer. Fern J. 73:113. 1983.

Distribution.—Common on soil, in rock crevices, and on trees in forest, 750–1000 m. Southern Mexico to Costa Rica.

Remarks.—On the basis of *Barkelew 236* and *Mason 1633*, Weatherby (in Johnston 1931:50) reported this fern as *Polypodium pulchrum* M. Martens & Galeotti. According to A. R. Smith, who annotated specimens at SD (*Felger 15817*; *Moran 5796*, 25500, 25502, 29520), the Socorro plant is *Polypodium alfredii*.

Polypodium polypodioides (L.) Watt var. *aciculare* Weath., Contr. Gray Herb. 124:33. 1939.

Distribution.—Common on trees in forest, 550–950 m. Southwestern Mexico and Central America.

Remarks.—Previously reported from Socorro by Weatherby, who cited *Barkelew 236* in the protologue to the variety.

Polystichum muricatum (L.) Fée, Mém. Foug. 5:278. 1852.

Distribution.—Uncommon on forest floor, at least 700–825 m. Southern Mexico to Jamaica, Haiti, and Venezuela.

Remarks.—Weatherby (in Johnston 1931:49) cited *Mason 1630* and *1677* and *Barkelew 227*. He wrote that the undersurface of the pinnae seemed much more fibrillose in the island plants than in most material from the mainland.

Pteridium caudatum (L.) Maxon, Proc. U.S. Natl. Mus. 23:631. 1901. *P. aquilinum* (L.) Kuhn var. *caudatum* (L.) Sadeb., Jahrb. Hamburg Wiss. Anst. 14 (Beih. 3):5. 1897.

Distribution.—Fairly common on brushy slopes in upper half of island; down to ca. 500 m on south slope, to at least to 275 m on west slope above Caleta Grayson, and to 90 m on north slope above Bahía Academy. Florida, West Indies, most of Mexico, to northern South America.

Psilotaceae

Psilotum nudum (L.) P. Beauv., Prod. Aethéog. 106, 112. 1805.

Distribution.—Reported for Socorro by Johnston (1931:48) on the basis of *Barkelew 218*; no new collections. The distribution of plants with close collection numbers suggests that Barkelew's collection might have come from the forested upper part of the island, possibly on the north side. Widely distributed in tropics.

ANGIOSPERMAE: DICOTYLEDONS

Key to Families

1. Plants vines climbing by tendrils
 2. Tendrils arising from inflorescence axis below flowers; leaves compoundSAPINDACEAE
 2. Tendrils arising from base of leaves; leaves simple
 3. Tendrils branched; leaves cordate but not lobedCUCURBITACEAE
 3. Tendrils unbranched; leaves trilobedPASSIFLORACEAE
1. Plants lacking tendrils
 4. Plants cactus-like, with flattened, leafless, fleshy stems covered with spinesCACTACEAE
 4. Plants not cactus-like
 5. Plants parasitic, attached to branches of shrubs or trees; leaves oppositeVISCACEAE
 5. Plants not parasitic, terrestrial, or if epiphytic and perhaps appearing parasitic, the leaves alternate or whorled
 6. Inflorescence a dense head subtended by an involucre; sepals dry scales, bristles, or absent, white to brown but not greenASTERACEAE
 6. Inflorescence various, but not an involucre head; sepals generally green
 7. Plants conspicuously woody: shrubs or trees
 8. Leaves compoundGROUP 1
 8. Leaves simple
 9. Leaves oppositeGROUP 2
 9. Leaves alternate
 10. Leaves entireGROUP 3
 10. Leaves crenate or toothedGROUP 4
 7. Plants herbaceous or base slightly woody
 11. Perianth absent or a single whorl (appearing to be sepals or petals, but not both)GROUP 5
 11. Perianth of 2 or more whorls, differentiated into sepals and petals
 12. Petals fused to each other at least at base to form a cup or tube, falling as a unitGROUP 6
 12. Petals free from each other at least at base and usually throughout, falling singly or in pairsGROUP 7

GROUP 1: SHRUBS OR TREES WITH COMPOUND LEAVES

1. Leaves palmateARALIACEAE
1. Leaves pinnate
 2. Leaflets entire; plants not aromatic; fruit a several-seeded legumeFABACEAE
 2. Leaflets crenate to serrate; plants aromatic; fruit of several one-seeded folliclesRUTACEAE

GROUP 2: SHRUBS OR TREES WITH OPPOSITE, SIMPLE LEAVES

1. Plants with milky juice; flowers unisexual, without perianth; inflorescence of a single carpellate flower and several staminate flowers subtended by an involucreEUPHORBIACEAE
1. Plants without milky juice; flowers perfect, or if unisexual then inflorescence not as above
 2. Ovary inferior
 3. Stipules absent; petals free; stamens more than 10MYRTACEAE
 3. Stipules present; petals fused; stamens 5 or 4RUBIACEAE
 2. Ovary superior
 3. Flowers inconspicuous, petals none; fruit a one-seeded drupe; stone longitudinally ribbedOLEACEAE
 3. Flowers conspicuous, petals present; fruit a capsule, 2–4 nutlets, or a two-seeded drupe
 4. Petals free, bright yellow; stamens more than 10; fruit a many-seeded capsuleHYPERICACEAE
 4. Petals fused, white, pink, violet, or blue, never bright yellow; stamens 4 or 2; fruit 2–4 nutlets or a two-seeded drupe
 5. Flowers strongly bilateral, solitary or in verticelsLAMIACEAE
 5. Flowers radial or nearly so, in dense terminal heads or spikesVERBENACEAE

GROUP 3: SHRUBS OR TREES WITH ALTERNATE, SIMPLE, ENTIRE LEAVES

1. Branches producing aerial roots that may reach the ground to form secondary trunks; terminal buds enclosed in large stipules; flowers borne on the inside of a globose, fleshy receptacle, the figMORACEAE

1. Branches not producing aerial roots; stipules, if present, small and not enclosing buds; flowers variously arranged, not inside a receptacle
 2. Flowers and fruits in globose, conelike heads; leaf blade with a pair of glands at baseCOMBRETACEAE
2. Flowers and fruits not in conelike heads; leaf blade without glands at base
 3. Fruit a winged capsule; leaves glutinousSAPINDACEAE
 3. Fruit an unwinged capsule, drupe, or berry; leaves not glutinous
 4. Plants succulent; ovary inferior; corolla strongly bilateralGOODENIACEAE
 4. Plants not at all succulent; ovary superior; corolla radial or nearly so
 5. Inflorescence one-sided and coiled; fruit drupaceous, containing four nutletsBORAGINACEAE
 5. Inflorescence various, but not one-sided and coiled; fruit a berry or capsule
 6. Fruit a one-seeded berry; plant with milky juice; stamens opposite corolla lobes, alternating with petaloid staminodesSAPOTACEAE
 6. Fruit a many-seeded capsule or berry; plants without milky juice; stamens alternate with corolla lobes; staminodes noneSOLANACEAE

GROUP 4: SHRUBS OR TREES WITH ALTERNATE, SIMPLE, TOOTHED LEAVES

1. Plants aromatic; bark smooth, exfoliating in thin sheets; fruit a 1-seeded leathery capsuleBURSERACEAE
1. Plants not aromatic; bark rough or if smooth, not exfoliating in thin sheets; fruit various, but if a capsule, containing more than 1 seed
 2. Petals absent, at least in carpellate flowers; flowers all unisexual; inflorescence a spike or raceme, with carpellate flowers below and staminate flowers aboveEUPHORBIACEAE
 2. Petals present in all flowers; flowers perfect, or if some or all of them unisexual, then the inflorescence not as above
 3. Fruit a spiny burTILIACEAE
 3. Fruit not spiny
 4. Fruit a follicle, capsule, or schizocarp
 5. Petals fused; stamens free from each other but fused to the corollaSOLANACEAE
 5. Petals free; stamens fused to each other
 6. Stamens many more than 10MALVACEAE
 6. Stamens 5STERCULIACEAE
 4. Fruit a berry or drupe
 7. Inflorescence an open panicle; 3 outer petals considerably larger than inner 2; stamens 2, opposite 2 petalsSABIACEAE
 7. Inflorescence various, but not a panicle; all petals essentially the same size; stamens 5 or more
 8. Flowers fascicled
 9. Leaves broadly obovate, about as long as wide; petals 4; stamens alternating with petals; drupes one-seededAQUIFOLIACEAE
 9. Leaves elliptic or narrowly obovate, 2-3 times as long as wide; petals 5; stamens opposite petals; drupes three-seededRHAMNACEAE
 8. Flowers in spikes, racemes, or cymes
 10. Petals free; stamens many more than 10; carpels freeROSACEAE
 10. Petals fused; stamens 5; carpels fused at least in ovary
 11. Inflorescence a terminal spike; style 4-branched; ovary 4-celledBORAGINACEAE
 11. Inflorescence a lateral or terminal cyme; style unbranched; ovary 2-celledSOLANACEAE

GROUP 5: HERBACEOUS PLANTS; PERIANTH NONE OR IN ONE WHORL

1. Plants with milky juice; inflorescence of a single carpellate flower and several staminate flowers subtended by an involucreEUPHORBIACEAE
1. Plants without milky juice; inflorescence various, but not as above
 2. Plants epiphytic; perianth absent; flowers minute; inflorescence a dense elongate terminal spike with inconspicuous bractsPIPERACEAE
 2. Plants terrestrial; perianth present; flowers larger; inflorescence various, if a terminal spike then the bracts conspicuous
 3. Leaves appearing whorled
 4. Perianth parts 4, fused; fruit a schizocarpRUBIACEAE
 4. Perianth parts 5, free; fruit a capsuleMOLLUGINACEAE
 3. Leaves alternate or opposite
 5. Leaves oppositeNYCTAGINACEAE
 5. Leaves alternate
 6. Leaves compound; inflorescence a compound umbelAPIACEAE
 6. Leaves simple; inflorescence a spike or the flowers solitary
 7. Perianth parts fused into a long tube; flowers strongly bilateral; fruit a 5-celled capsuleARISTOLOCHIACEAE
 7. Perianth parts free or nearly so; flowers radial; fruit a utricle
 8. Bracts and perianth dry, scarious; bracts spine-tippedAMARANTHACEAE
 8. Bracts and perianth herbaceous; bracts not spine-tippedCHENOPODIACEAE

GROUP 6: HERBACEOUS PLANTS; PETALS FREE

1. Leaves compound
 2. Ovary inferior; inflorescence a compound umbelAPIACEAE
 2. Ovary superior; inflorescence a spike, raceme, or panicle, or the flowers solitary
 3. Ovary 5-celled; fruit a schizocarp, separating into 5 spiny mericarpsZYGOPHYLLACEAE

- 3. Ovary 1-celled; fruit a legume or capsule
 - 4. Ovary with 2 carpels; placentation parietal; fruit a capsule CAPPARIDACEAE
 - 4. Ovary with 1 carpel; placentation marginal; fruit a legume FABACEAE
- 1. Leaves simple
 - 5. Sepals 2; leaves succulent; ovary partly inferior PORTULACACEAE
 - 5. Sepals 3 or 5; leaves not succulent; ovary completely superior
 - 6. Sepals 3, caducous; petals 6; plants spiny PAPAVERACEAE
 - 6. Sepals 5, persistent; petals 5; plants not spiny
 - 7. Stamens 5 STERCULIACEAE
 - 7. Stamens more than 10
 - 8. Stamens free or nearly so; fruit an elongate capsule TILIACEAE
 - 8. Stamens fused into a tube surrounding the ovary; fruit a schizocarp or \pm globose capsule MALVACEAE

GROUP 7: HERBACEOUS PLANTS; PETALS FUSED

- 1. Leaves opposite
 - 2. Plant a twining vine with milky juice; stamens fused to stigma; fruit one or two follicles ASCLEPIADACEAE
 - 2. Plant not twining; milky juice absent; stamens free from stigma; fruit a capsule or schizocarp
 - 3. Ovary inferior; petals 4; leaves entire RUBIACEAE
 - 3. Ovary superior; petals 5 or if appearing 4 then the leaves toothed
 - 4. Stamens 5; anthers spirally twisted GENTIANACEAE
 - 4. Stamens 4 or 2; anthers straight
 - 5. Corolla radial or nearly so VERBENACEAE
 - 5. Corolla strongly bilateral
 - 6. Plants aromatic; fruit 4 nutlets LAMIACEAE
 - 6. Plants not aromatic; fruit a capsule SCROPHULARIACEAE
 - 1. Leaves alternate or basal
 - 7. Leaves basal; stems clothed with imbricated scale-like bracts ACANTHACEAE
 - 7. Leaves scattered along stem, alternate; stems without scale-like bracts
 - 8. Stamens more than 10, fused by the filaments but the anthers free MALVACEAE
 - 8. Stamens 5 or 4, free or if fused by the filaments then the anthers also fused
 - 9. Ovary inferior CAMPANULACEAE
 - 9. Ovary superior
 - 10. Corolla bilateral; stamens 4 SCROPHULARIACEAE
 - 10. Corolla radial; stamens 5
 - 11. Inflorescence one-sided and coiled; ovary 4-celled; fruit a schizocarp BORAGINACEAE
 - 11. Inflorescence not one-sided and coiled; ovary 2-celled; fruit a capsule
 - 12. Styles, style branches, or stigmas 2; sepals free nearly to the base CONVULVULACEAE
 - 12. Style and stigma 1; sepals fused through much of their length, only the lobes free SOLANACEAE

Acanthaceae

Elytraria imbricata (Vahl) Pers., Syn. Pl. 1:23. 1805.
E. tridentata Vahl, Enum. Pl. 1:107. 1804.
E. squamosa (Jacq.) Lindau, Anales Inst. Fis-Geogr. Nac. Costa Rica 8:299. 1895.

Distribution.—Widespread on island, from shore to summit, but uncommon. Arizona and Texas to Brazil.

Remarks.—Anthony's specimens are labeled *E. tridentata*, and Johnston (1931:96) called the plant *E. squamosa*. Both names are now considered synonyms of *E. imbricata*.

Amaranthaceae

***Amaranthus palmeri** S. Watson, Proc. Amer. Acad. Arts 12:274. 1877.

Distribution.—Weed in abandoned field, El Ranchito, north of Caleta Castelan (*Felger 15863*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1967. Weed throughout southwestern United States, Baja California, to central Mexico; introduced in central and eastern United States.

Apiaceae

Daucus montanus Humb. & Bonpl. ex Sprengel in Roemer & Schultes, Syst. Veg. 6:482. 1820.

Distribution.—Fairly common near summit of Cerro Evermann, 950–1040 m (*Felger 15759*; *Levin 1815*; *Miranda 8739*; *Moran 5803*, 29507). Not previously reported for Socorro. Northern Mexico to Chile.

Aquifoliaceae

Ilex socorroensis T. S. Brandege, Univ. Calif. Publ. Bot. 4:90. 1910.

Distribution.—Common in forest above ca. 550 m and occasional in scrub and grassland to summit; on north ridge down to 450 m. Endemic to Isla Socorro; type without exact locality, *Barkewell 179* (UC 136719).

Remarks.—In the forest this is a tree to 10 m tall, with a branch spread up to 14 m; the largest trunk measured was 4.5 \times 3.0 dm. In more exposed places, as on the north ridge and near the summit of Cerro Evermann, it is a shrub 2–3 m tall. It flowers from December to April.

According to Johnston (1931:72), this tree has no

obvious relations in Mexico or Central America but is related to *I. repanda* Griseb. of the West Indies. *I. socorroensis* looks much like the widespread Mexican *I. toluhana* Hemsley, however, differing mainly in leaf shape. Although leaf shape is similar in *I. socorroensis* and *I. repanda*, leaves of *I. socorroensis* have distinctly crenulate-serrate margins as in *I. toluhana*, whereas the leaf margins of *I. repanda* are wavy with at most a few weak crenulations and are often entire. Resolution of the relationships among these species awaits a modern revision of the genus.

Araliaceae

Oreopanax xalapense (Kunth) Decne. & Planchon, Rev. Hort. ser. 4. 3:108. 1854.

Distribution.—Uncommon in upper part of forest, 800–950 m. Jalisco and Veracruz to Panama.

Aristolochiaceae

Aristolochia socorroensis Pfeifer, Tax. Rev. Pentandr. Spp. Aristolochia 82, fig. 26. 1970.

Distribution.—Occasional on low seabluffs and upper beach, Bahía Academy; south slope of Cerro Evermann, 800 m; abandoned field north of Caleta Castelan; Bahía Braithwaite. Endemic to Isla Socorro; type from Bahía Academy at 15 m, *Moran 5910* (DS).

Remarks.—Vasey and Rose (1890:149), Brandegee (1900b:27), and Johnston (1931:59) all reported this plant as *A. brevipes* Benth. Although most Mexican herbaceous aristolochias have been called *A. brevipes*, Pfeifer (1970:87) considered that species restricted to lava fields in central Mexico. When he named *A. socorroensis*, Pfeifer (p. 72) also proposed *A. islandica* for the plants of Isla San Benedicto. Unfortunately, he did not discuss the relationships of either species. Whereas we accept these two endemic insular species, Wiggins

(1964:407; 1980:97) included the Revillagigedos in the range of the wide-ranging species he called at first *A. brevipes* var. *acuminata* S. Watson and later *A. porphyrophylla* Pfeifer. According to Pfeifer (1976), the correct name for this mainland species is *A. watsonii* Wootton & Standley.

Asclepiadaceae

Key to Species

- 1. Leaves ovate-lanceolate *Cynanchum californicum*
- 1. Leaves linear *Cynanchum sonorensis*

Cynanchum californicum (Benth.) Moran, comb. nov.
Metastelma californicum Benth., Bot. Voy. Sulphur 33, t. 18. 1844.

Distribution.—Occasional around island, from shore at least to 450 m, climbing over shrubs (*Barkew 217*; *Dominguez 737*; *Felger 15872*; *Levin 1797*; *Moran 5865, 25466, 25486, 25519, 25533*). Central and southern Baja California; a report from Jalisco is unlikely (Wiggins 1964:1122).

Remarks.—On the basis of Barkew's sterile and nearly leafless specimen, Johnston (1931:83) reported this plant as an unidentified species of *Metastelma*. While working on *Metastelma*, R. W. Holm identified our specimens of this and the next species and suggested that, following Woodson (1941), both species belong in *Cynanchum*.

Cynanchum sonorensis Moran, nom. nov.

Metastelma minutiflorum Wiggins, Contr. Dudley Herb. 3:71. 1940; non *Cynanchum minutiflorum* Schumann, 1895.

Distribution.—Occasional in low open *Croton* scrub, ridge south of Bahía Academy, 100 m (*Moran 5873*). Not previously reported from Socorro. Sonora and Sinaloa.

Asteraceae

Key to Species

- 1. Corollas of all flowers strap-shaped and 5-toothed at apex; plants with milky juice
 - 2. Leaves serrate or with broad lobes *Sonchus asper*
 - 2. Leaves pinnately parted into narrow lobes *Sonchus tenerrimus*
- 1. Corollas of at least some flowers tubular and radial (disk flowers), marginal flowers often strap-shaped and 2–3-toothed at apex (ray flowers); plants without milky juice
 - 3. Ray flowers conspicuous
 - 4. Receptacle chaffy
 - 5. Rays white *Bidens socorroensis*
 - 5. Rays yellow
 - 6. Plants less than 40 cm tall; leaves dissected into linear lobes *Coreocarpus insularis*
 - 6. Plants more than 1 m tall; leaves simple, ovate to deltoid *Viguiera chenopodioides*
 - 4. Receptacle naked
 - 7. Leaves oblanceolate; heads paniculate, small, the disks less than 5 mm wide *Erigeron socorroensis*
 - 7. Leaves ovate; heads solitary, larger, the disks 1 cm wide or more *Perityle socorroensis*
 - 3. Ray flowers minute or absent
 - 8. Heads unisexual, the staminate above, the pistillate involucre modified into a spiny bur *Ambrosia confertiflora*
 - 8. Heads all alike

9. Leaves opposite
 10. Phyllaries conspicuously striate, strongly graduated, the longest at least 1 cm long *Brickellia peninsularis*
 10. Phyllaries not conspicuously striate, all about the same length, the longest less than 5 mm long. *Eupatorium pacificum*
9. Leaves alternate
 11. Plants scandent shrubs climbing to over 2 m; leaves broadly ovate, over 4 cm wide *Vernonia littoralis*
 11. Plants erect herbs up to about 1.5 m tall; leaves obovate, oblanceolate, or linear, rarely more than 2 cm wide
 12. Plants silky but greenish, glandular-viscid; leaves coarsely serrate along their entire margin .. *Pseudoconyza viscosa*
 12. Plants (except the upper leaf-surface) densely white-woolly, not glandular; leaves entire or with a few teeth near the apex
 13. Leaves, at least the basal, with a few teeth near the apex; phyllaries subherbaceous, at least the outer with green or purplish tips *Conyza confusa*
 13. Leaves all entire; phyllaries dry and scarious, entirely straw-colored or light brown
 14. Pappus bristles united into a ring a base and falling as a unit; inflorescence spike-like *Gnaphalium sphacilatum*
 14. Pappus bristles free, not united at base, falling separately; inflorescence a panicle *Gnaphalium attenuatum*

***Ambrosia confertiflora** DC., Prodr. 5:526. 1836.

Distribution.—Uncommon near the naval base, 15 m (*Dominguez 747*). Not previously reported for Socorro and evidently a recent arrival, first collected there in 1988. Southwestern United States to central Mexico; adventive in Hawaii and Puerto Rico.

Bidens socorrensis Moran & Levin, sp. nov. (Figure 10)

Type.—Isla Socorro, Mexico: fairly common in low vegetation at 950 m on the east slope near the summit of Cerro Evermann, near 18°46.5'N, 110°57.5'W, 4 April 1981, *Moran 29509* (Holotype: SD 108329; isotypes: CAS, F, MEXU, US).

Suffrutex hirsutulus 4–12 dm altus. Folia plerumque simplicia, laminis ovato-lanceolatis ad rhombico-ovatis acutis serratis 2–7 cm longis 1–3 cm latis, petiolis 0.5–1.5 cm longis. Capitula solitaria paucave radiata 2.5–3.5 cm lata. Involucra extra hispidula, bracteis exterioribus 8–9 lineari-ellipticis 5–8 mm longis triplinervatis apice processu conico indurato ca. 0.2 mm longo latoque munitis, bracteis interioribus oblongo-lanceolatis apice ciliatis 7–9 mm longis multinervatis. Flores ligulati saepius 8, laminis albis subflavescentibus 12–15 mm longis 5–7 mm latis. Flores disci ca. 40, corolla subflava 5 mm longa. Achaenia lineari-elliptica atra apicem versus subflava 7–9 mm longa biaristata. Typus: *Moran 29509* (SD 108329). Species *B. albae radiatae* et *B. odoratae* affinis sed habitu perenni, foliis saepius simplicibus, floribusque ligulatis fere 8 distinguitur.

Perennial herb, becoming somewhat woody at base, 4–12 dm tall, or even to 16 dm when supported by shrubs, simple or branching below, commonly with several ascending branches above. Herbage hispidulous, the trichomes simple, several-celled, crisped, tawny or whitish, 0.3–0.9 mm long, somewhat matted on young growth. Stems at first subquadrangular, the two faces below leaves convex, each with about 5–7 often reddish longitudinal ridges, the alternate faces narrower, concave, each with about 3 longitudinal ridges; at length stems terete and longitudinally ridged, to 1.5 cm thick at base; lower internodes ca. 0.5–5 cm long, the upper 3–13 cm long. Leaves petiolate, simple or lower sometimes 2–3-foliolate, the blades rhombic-ovate to ovate-lanceolate, acute, cuneate below, 2–7 cm long,

1–3 cm wide, with ca. 7–15 veins departing on each side of midvein at ca. 45°, the margins rarely entire, mostly crenate-serrate in upper half to three-fourths, with ca. 6–30 teeth on each margin, or sometimes shallowly lobed, the petioles 0.5–1.5 cm long, often narrowly winged above, slightly connate at base. Heads solitary or few and laxly corymbose, 2.5–3.5 cm wide, the peduncles 3–7 cm long, leafless or with few reduced leaves near base. Receptacle flat. Involucre hemispheric, ca. 7–10 mm wide, in fruit to 20 mm wide; outer phyllaries 8–9, linear-elliptic, acute, 5–8 mm long, 1–1.5 mm wide, conspicuously 3-nerved, densely hispidulous dorsally, with conic terminal process ca. 0.2 mm long and wide; inner phyllaries ca. 8, oblong-lanceolate, obtuse and ciliate at apex, 7–9 mm long, 2.5–3 mm wide, hispidulous dorsally where exposed, glabrous and somewhat petaloid ventrally, with ca. 20 close parallel red nerves, the wide margins nerveless. Paleae similar to inner phyllaries but 1.5–2 mm wide, glabrous except for ciliate apex. Ray florets sometimes 7 but mostly 8, neutral, the ovary 2 mm long, the tube 2–2.5 mm long, the blade white drying yellowish, oblong to broadly elliptic, rounded and shortly 3-toothed at apex, 12–15 mm long, 5–7 mm wide, with 7–12 reddish nerves. Disk florets ca. 40, 5-merous; corolla yellowish, ca. 5 mm long, with conspicuous reddish nerves alternating with lobes, the tube ca. 1.5 mm long, expanding abruptly into narrowly campanulate limb ca. 3 mm long and 1.5 mm wide, the lobes deltoid-ovate, acute, puberulent, ca. 0.75 mm long, somewhat reflexed; anthers ca. 2 mm long, sagittate at base; style branches recurved, ca. 1.2 mm long including appendages, 0.3 mm wide, 0.15 mm thick, the appendage 0.3 mm long. Achenes black, yellowish at apex, minutely papillose, linear-elliptic, rhombic in cross section with each face bisulcate, 7–11 mm long, 0.8–1.0 mm wide, and 0.6–0.75 mm thick at middle, 0.5–0.7 mm wide at apex and just above base, bearing yellowish antrorse bristles ca. 0.1–0.4 mm long especially at apex and on



Fig. 10. Holotype of *Bidens socorrensis*.

angles; aristae 2, often unequal, to 2.3 mm long when well developed bearing retrorse bristles, but one or both sometimes subobsolete.

Paratypes.—Hillside above Playa Blanca, east-southeast of Cabo Henslow, 120 m, *Moran 25488* (ENCB, SD, UC); brush-covered north ridge midway between Cerro Evermann and Bahía Academy, 450 m, *Moran 5862* (NY, SD); south slope of Cerro Evermann, 1030 m, *Felger 15764* (ARIZ, BM, CAS, F, SD, TEX), *Moran 5819* (F, SD); among rocks on ridge south of Cerro Evermann, 800 m, *Miranda 8716* (MEXU, SD); same vicinity, *Carlquist 354* (RSA); upper south slope of peak south of Cerro Evermann, 700 m, *Moran 5781* (F, MO, SD, US); brushy ridge east-northeast of Caleta Grayson, 350 m, *Levin 1799* (SD, TENN); slopes above Caleta Grayson, 325 m, *Moran 25464* (BISH, DAV, ENCB, CIB, SD); without exact locality, *Barkelew 241* (UC).

Distribution.—Endemic to Isla Socorro. Widespread but not usually common in scrub on the northern two-thirds of the island, becoming more common near the summit.

Relationships.—*Bidens socorrensis* belongs to the *Bidens pilosa* complex, which Sherff (1937, 1955) treated as a single species with many subordinate taxa. Melchert (1976) and Ballard (1986), however, divided the North and Central American plants into three species. From all three, *B. socorrensis* is easily distinguished by its perennial habit, mostly simple leaves, (7-)8-rayed heads, and longer (5–8 mm vs. 2–5 mm) outer phyllaries. In Ballard's treatment, which is more complete, *B. socorrensis* appears closest to *B. alba* var. *radiata* (Schultz-Bip.) Ballard, which also has rays with blades about twice as long as wide, or to *B. odorata* Cav., which also has about eight linear outer phyllaries. *B. alba radiata* is a plant of moist low elevations (generally below 600 m) in Florida, the West Indies, eastern Mexico, and northern Central America; *B. odorata* grows in the mountains and high plateaus of the southwestern U.S., central and western Mexico, and northern Central America, usually at elevations above 100 m (Melchert 1976, McVaugh 1984, Ballard 1986). It would be valuable to know the chromosome number of *B. socorrensis*, because *B. odorata* is a diploid ($n = 12$) whereas *B. a. radiata*, with $n = 24$, is a tetraploid (Ballard 1986). The two mainland species also differ in their leaf flavonoids (Ballard 1986).

Dispersal.—Carlquist (1966, 1974:444–445) illustrated the achenes of *B. socorrensis* and discussed their dispersibility. Insular members of the *B. pilosa* complex have less efficient dispersal mechanisms than do mainland members. *B. socorrensis*, however, with its barbed aristae and hairy achenes, has retained more

of the features that aid dispersal than have most insular *Bidens*. We note, though, that one or both aristae are sometimes subobsolete.

Brickellia peninsularis T. S. Brandegees var. **amphithalassa** Robinson ex I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:100. 1931.

Distribution.—Rather common in brushy places from shore to summit. The variety is endemic to islas Socorro and Clarión; type from Isla Clarión (*Mason 1555*).

Remarks.—This is a weak shrub, generally 1–2 m tall but shorter on exposed seaward slopes. The corollas are yellowish white, but the heads appear yellow because of the prominent yellow anthers.

The var. *peninsularis* is endemic to southern Baja California.

Conyza confusa Cronq., Bull. Torrey Bot. Club 70:632. 1943.

Distribution.—Uncommon and local on northeast slope near summit of Cerro Evermann, 1020 m (*Felger 15753*, *15813*; *Levin 1820*; *Moran 29508*). Not previously reported for Socorro. Central and western Mexico from Durango to Chiapas.

Remarks.—J. L. Strother, who identified the specimens, noted (pers. comm.) that the island material had more robust rosettes and more pubescent leaves than the mainland material he had seen. On this basis he felt that the plant was not a recent arrival on Socorro.

Coreocarpus insularis (T. S. Brandegees) E. B. Smith, Brittonia 36:274. 1984. *Leptosyne insularis* T. S. Brandegees, Erythea 7:5. 1899. *Coreopsis insularis* (T. S. Brandegees) S. F. Blake, Proc. Amer. Acad. Arts 49:340. 1913.

Distribution.—Locally common in scattered populations from near Caleta Grayson up west and southwest slopes of Cerro Evermann at least to 700 m. Endemic to Isla Socorro; type without exact locality, *Anthony 394* (UC 89282).

Remarks.—From the root-crown, often 1 to 1.5 cm thick, grow several erect to arching or prostrate perennial stems 1 to 8.5 dm long and 2 to 5 mm thick, which are conspicuously ringed with the somewhat persistent connate leaf bases. The peduncles are 4 to 23 cm long.

Blake (1913) and Johnston (1931:103) thought this species most closely related to *Coreopsis cyllocarpa* S. F. Blake and its var. *pinnatisecta* (S. F. Blake) Crawford, plants of grassy plateaus above 1500 m in western Mexico, from Jalisco to Oaxaca (Crawford 1970, Smith 1984). E. B. Smith (pers. comm.) noted that these species are superficially similar but considered *C. insularis*

more closely related to *Coreocarpus dissectus* (Benth.) S. F. Blake, endemic to southern Baja California.

Erigeron socorrensis T. S. Brandege, *Erythea* 7:4. 1899.

Distribution.—Brushy places from shore to summit; common in northern and central parts of island but uncommon in southern part, where perhaps reduced by sheep. Endemic to Isla Socorro; type without exact locality, *Anthony* 376 (UC 174214).

Remarks.—This is a weak shrub 3 to 15 dm tall, with stems to 1.5 cm thick at the base.

This species is closely related to *E. crenatus* Eastwood ex I. M. Johnston of Isla San Benedicto, which, in fact, Blake (1926:1499) earlier included in the same species. Johnston (1931:101–102) found the relationships of these two species obscure but placed them in sect. *Caenotus* and suggested that their most probable relatives were found in southern Mexico. No members of this section are known in Baja California.

Eupatorium pacificum Robinson ex I. M. Johnston, *Proc. Calif. Acad. Sci.*, ser. 4, 20:99. 1931. *Ageratina pacifica* (Robinson ex I. M. Johnston) R. King & H. Robinson, *Phytologia* 19:215. 1970.

Distribution.—Rather common in rocky places from 800 m to summit. Endemic to Isla Socorro; type from near the summit, *Mason* 1666 (CAS 186613).

Remarks.—This is a shrub 6 to 10 dm tall, branching from the base.

According to B. L. Robinson (in Johnston 1931:99), this species is similar to *E. pazcuarensis* Kunth and *E. conspicuum* Kunth & Bouché, both of southern and western Mexico. H. Robinson (pers. comm.) thought *E. pacificum* probably more closely related to *E. bustamenta* DC., which extends from central Mexico to Panama and has other close relatives in western Mexico.

Gnaphalium attenuatum DC., *Prodr.* 6:228. 1837.

Distribution.—Uncommon, near summit of island, above 750 m. Central Mexico to Panama.

Gnaphalium sphacilatum Kunth in Humb., *Bonpl. & Kunth*, *Nov. Gen. Sp.* 4:67. 1818.

Gnaphalium pedunculatum I. M. Johnston, *Contr. Gray Herb.* II. 68:99. 1923.

Distribution.—Rare in open spots in summit grassland, east slope near summit of Cerro Evermann (*Felger* 15760; *Moran* 29514). Not previously reported for Socorro. West-central Mexico and Baja California. The occurrence near the summit very likely is native, even though the first collection was not made until 1967.

Remarks.—The Socorro material appears to belong

to this species, but, as noted by McVaugh (1984: 450–451), the taxonomy of this species-complex is not well understood.

Perityle socorrensis Rose, *Bot. Gaz.* 15:118, pl. 13, fig. 9. 1890.

Distribution.—Nearly confined to seacliffs, where it is common (Cabo Middleton, Bahía Academy, Playa Blanca, Caleta Grayson, southwest of Cabo Pearce, Caleta Binner, Cabo Rule). One old plant found in bare ground among scattered shrubs north of Huerta Grande at 330 m (*Moran* 29535). Endemic to the Revillagigedos, found on islas Socorro, San Benedicto, and Clarión; type from Isla Socorro without exact locality, but presumably from Bahía Braithwaite, *Townsend s. n.* (US).

Remarks.—Powell (1974) thought this species most closely related to *P. crassifolia* T. S. Brandege of southern Baja California, a plant that also is primarily coastal. Both species have $2n = 38$ (Powell 1983).

We have used Rose's original spelling rather than the more euphonious *socorrensis* used by some later authors (e.g., Powell 1974).

***Pseudoconyza viscosa** (Miller) D'Arcy, *Phytologia* 25:281. 1973. *Conyza viscosa* Miller, *Gard. Dict.* ed. 8. 1768. *Blumea viscosa* (Miller) Badillo, *Revista Fac. Agron. (Maracay)* 7(3):9. 1974.

Distribution.—Common in disturbed areas north of Bahía Braithwaite (*Levin* 1767). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Common weed from the West Indies and western and southern Mexico to northern South America.

***Sonchus asper** (L.) Hill, *Herb. Brit.* 1:47. 1769.

Distribution.—Common on flat at east side of Laguna Escondida (*Moran* 29538). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1981. Cosmopolitan weed, native of Europe.

***Sonchus tenerimus** L., *Sp. Pl.* 794. 1753.

Distribution.—Occasional weed at roadside, naval base, Cabo Rule (*Moran* 25441). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Widely naturalized from central California to southern Baja California; native of Europe.

Vernonia littoralis T. S. Brandege, *Erythea* 7:3. 1899.

Eremosis littoralis (T. S. Brandege) Gleason, *N. Am. Fl.* 33:100. 1922.

Distribution.—Occasional, climbing over trees and shrubs, 300–900 m. Endemic to Isla Socorro; type

without exact locality, *Anthony s. n.* (UC 86053).

Remarks.—One plant (*Moran 5760*) was scandent, 7 m long, the trunk 9 cm thick, the bark thick, furrowed, almost black.

Although it is not clear from the literature (Blake 1926, Gleason 1922, Jones 1973) to what species *V. littoralis* is most closely related, all authors agree that it belongs to a group ranging from southern Mexico to Honduras.

Viguiera chenopodina E. Greene, Leaflets Bot. Observ. Crit. 2:154. 1911.

Viguiera deltoidea A. Gray var. *townsendii* Vasey & Rose, Proc. U.S. Natl. Mus. 13:148. 1890. Type from Isla Socorro without exact locality but presumably from Bahía Braithwaite, *Townsend s. n.* (US).

Distribution.—From shore to summit, common in *Croton* scrub and occasional above. Southern Baja California to Isla Tiburón, Sonora.

Remarks.—On Socorro, this is a shrub 1–2.5 m high or clambering to 5 m, the trunk to 8 cm thick.

Although Blake (1918) maintained the Socorro plant as an endemic variety of *V. deltoidea*, he pointed out that it approached *V. deltoidea* var. *chenopodina* (E. Greene) S. F. Blake. Johnston (1931:103) questioned the validity of separating these two taxa. On the basis of his studies of morphology, chemistry, and cytology, E. E. Schilling (pers. comm.) recognized *V. chenopodina* as a distinct species. He noted (pers. comm.) that the Socorro material does not completely match any other sample of the species but does closely approach some material from islands in the Gulf of California. Furthermore, using flower buds Levin collected, Schilling (pers. comm.) found that the Socorro plant has $2n = \text{ca. } 54$ and is therefore a hexaploid like *V. chenopodina*. He would therefore include the Socorro plant in *V. chenopodina*.

Boraginaceae

Key to Species

1. Plants herbs; fruit dry, separating into 2 or 4 bony nutlets *Heliotropium curassavicum*
1. Plants shrubs; fruit drupaceous
 2. Leaves entire; inflorescence a panicle of coiled cymes *Tournefortia hartwegiana*
 2. Leaves toothed; inflorescence spike-like *Cordia curassavica*

Cordia curassavica (Jacq.) Roemer & Schultes, Syst. Veg. 4:460. 1819.

C. brevispicata M. Martens & Galeotti, Bull. Acad. Roy. Sci. Bruxelles 11:311. 1844.

C. socorrensis T. S. Brandegee, Erythea 7:5. 1898. Type from Isla Socorro without exact locality, *Anthony 384* (UC).

Distribution.—Occasional in arroyos in *Croton* scrub at south end and in *Dodonaea-Lepechinia* scrub on south slope up to 800 m; more common in mixed scrub on north and west sides of island, on alluvial flats sometimes in pure stands, as at Bahía Academy. Western Mexico from southern Baja California and central Sonora south, West Indies, Central America, and northern South America.

Remarks.—Johnston (1949) only tentatively included *C. brevispicata* (and thus *C. socorrensis*) in *C. curassavica*. Miller (1988), however, found that these and the numerous other segregates from *C. curassavica* intergrade too much to allow their separation.

Heliotropium curassavicum L., Sp. Pl. 130. 1753.

Distribution.—Occasional on upper beach in northern part of island (Playa Blanca, Bahía Academy). Widespread in tropical and subtropical America.

Tournefortia hartwegiana Steudel, Nomencl. Bot. ed. 2, 2:693. 1841.

Distribution.—Occasional in *Croton* scrub on hillsides near shore at south end (Caleta Binner, Caleta Castelán). Southern Baja California to Tamaulipas and Oaxaca.

Burseraceae

Bursera epinnata (Rose) Engl., Nat. Pflanzenfam. ed. 2, 19a:425. 1931.

B. nesopola I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:66. 1931. Type from Caleta Binner, *Mason 1609* (CAS 186618).

Distribution.—Uncommon, scattered in *Croton* scrub at south end (Caleta Binner; Cabo Rule; above Caleta Castelán, 150 m). Southern Baja California.

Remarks.—Johnston compared *B. nesopola* with *B. rhoifolia* (Benth.) I. M. Johnston, now regarded as a synonym of *B. hindsiana* (Benth.) Engl. However, the Socorro plant seems essentially like *B. epinnata*—if indeed that is distinct from *B. hindsiana*. Wiggins (1964:757) included *B. nesopola* in the synonymy of *B. epinnata*.

Cactaceae

Opuntia sp.

Distribution.—Uncommon in northern part of island and only near shore (Bahía Academy, Playa Blanca, Caleta Grayson); fairly common in southern part, in *Croton* scrub and in rather bare areas above, to 400 m.

Description.—Shrub 0.5–2 m high, in age with indefinite trunk. Joints subcircular to mostly obovate, 15–30 cm long, 13–23 cm wide, glabrous, green, with areoles ca. 60 per joint (both sides) and thus widely

separated, adjacent ones ca. 2–5 (–7) cm apart. Areoles circular or slightly elongate, 4–11 mm long, 4–8 mm wide, with cushion of somewhat tawny wool projecting ca. 2–3 mm from surface of joint, all spiny except sometimes the lowest. Glochids mostly at upper side of areole, yellow, mostly ca. 3–4 mm long and projecting ca. 2 mm from surface of joint, a few longer. Spines mostly ca. 4–6 per areole, variously spreading, light yellow to whitish, becoming gray, acicular but commonly ca. twice as wide as thick at base, the largest 1.5–4 cm long, to 1 mm wide at base, often somewhat twisted, scarcely barbed. Flowers 5–6 cm long, 4–5 cm wide. Ovary obpyramidal, ca. 2.5–3 cm long and 2–2.5 cm wide, papillose, with ca. 20–25 areoles mostly crowded near apex; the areoles circular, tawny, 2–3 mm wide, with yellow glochids and the upper each with 1–3 acicular yellow spines to 8 mm long. Petaloid perianth parts yellow, the inner cuneate-obovate, rounded to emarginate, 25–32 mm long, 20–25 mm wide. Inner filaments ca. 4 mm and outer ca. 9–13 mm long;

anthers ca. 1.5 mm long. Style rosy, 16–24 mm long, ca. 5 mm thick above narrowed base, 3 mm thick above; stigma lobes greenish. Fruit red, obovoid to subglobose, truncate and scarcely umbilicate, 18–45 mm long, 20–35 mm thick. Seeds numerous (to ca. 70), irregular, 2.4 mm long, ivory (Figure 11A–C).

Plants at the north end are smaller—e.g., *Moran* 25495 (rather bare west slope, Playa Blanca, 25 m) 6 dm high, the joints 15–23 cm long, the fruit 18–30 × 20–32 mm (Figure 11D).

Remarks.—Having seen no specimens, Johnston (1931:80) reported this plant only as *Opuntia* species. Elzada Clover (H. S. Gentry 1949:71) identified sterile specimens collected by Elmore as *O. occidentalis* Engelm. & Bigelow, a plant described from southern California; that name is now considered a synonym of *O. ficus-indica* (L.) Miller, and the plants to which it has commonly been applied are considered a hybrid swarm derived from the introduced *O. ficus-indica* and varieties of *O. littoralis* (Engelm.) Cockerell, native to

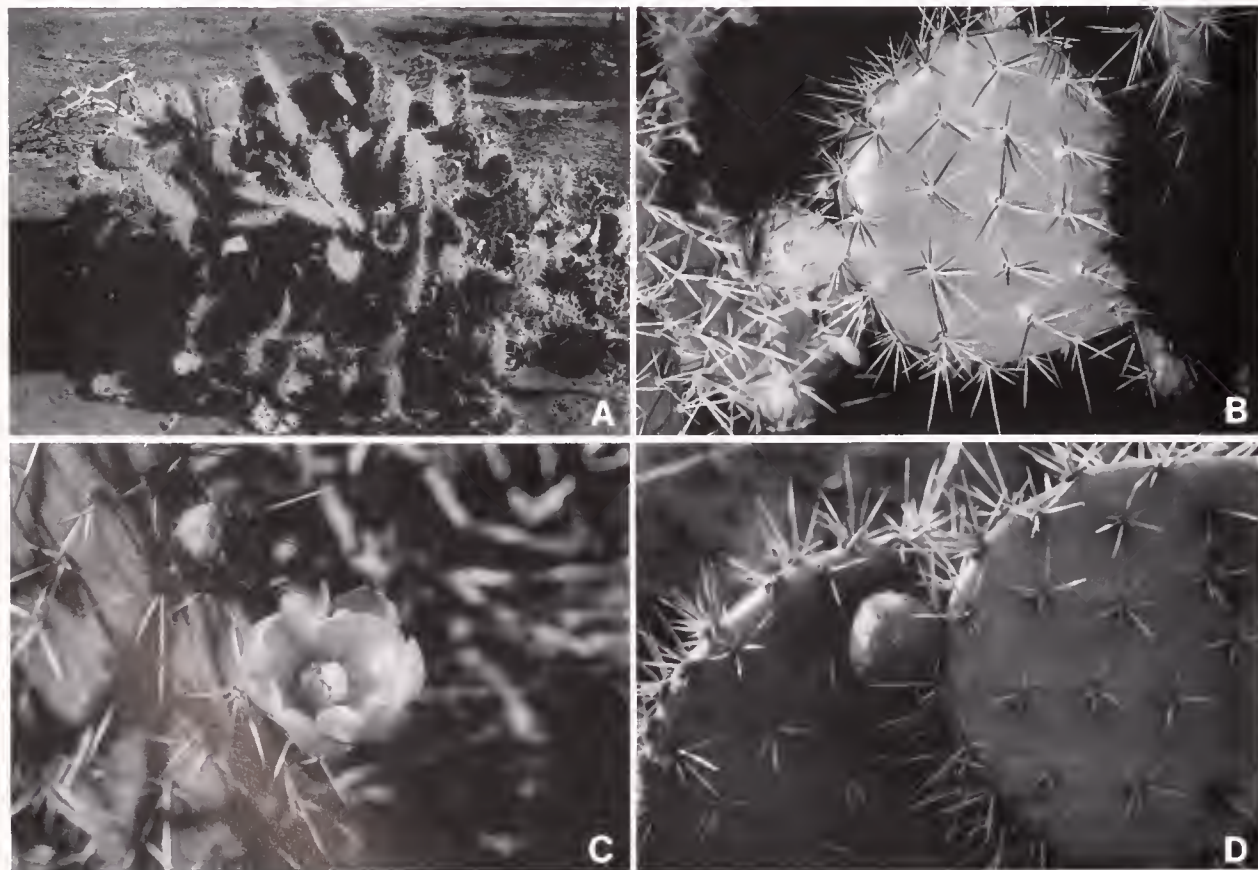


Fig. 11. *Opuntia* sp. Undescribed species from Isla Socorro. A, habit of plant growing northwest of Cabo Pearce (*Moran* 25514); B, pad and fruit of same plant; C, flower of plant growing near km 6 on airport road (*Moran* 25516); D, pad and fruit of plant growing near Playa Blanca (*Moran* 25495).

southern California (Benson and Walkington 1965). Brattstrom (1953), having collected the *Opuntia* of Socorro in flower and that of Clarión in fruit, considered them to be of the same species. He described the plant briefly and identified it somewhat equivocally as *O. engelmannii* Salm-Dyck ex Engelm. The Socorro *Opuntia* differs from *O. engelmannii* in being somewhat shorter and, more significantly, in having slender glochids clustered at the top of the areole rather than stout glochids distributed throughout the areole (Parfitt and Pinkava 1988). In Bravo-Hollis's (1978) treatment of Mexican *Opuntia*, it keys to series *Dillenianae* Britton & Rose, but it is not much like any of the species. The classification of the subgenus *Opuntia* seems somewhat artificial, and relationships among the species are poorly understood. Because we are so unsure of the proper placement of this species, we are unwilling to name it.

Campanulaceae

Key to Species

1. Flowers bilateral; stamens fused *Heterotoma cordifolia*
1. Flowers radial; stamens free *Triodanis perfoliata*

Heterotoma cordifolia (Hook. & Arn.) McVaugh, Bull. Torrey Bot. Club 67:143. 1940.

Distribution.—Occasional in shade of upper forest and scrub on the north and east slopes above ca. 700 m, and among rocks on the northwest slope from ca. 900 m to near summit (*Levin 1824; Moran 5825, 29502, 29513*). Not previously reported for Socorro. Chihuahua and southern Sonora to Costa Rica.

Triodanis perfoliata (L.) Nieuwl. var. ***biflora*** (Ruíz Lopez & Pavón) Bradley, Brittonia 27:114. 1975.

Distribution.—Scarce in rock crevices near summit of Cerro Evermann (*Levin 1817; Moran 5844*). Not previously reported from Socorro. Oregon to the Cape region of Baja California; south-central and south-eastern United States south to central Mexico; South America.

Capparidaceae

****Cleome viscosa*** L., Sp. Pl. 672. 1753. *Polanisia viscosa* (L.) DC., Prodr. 1:242. 1824.

Distribution.—Uncommon south of the airstrip at 260 m (*Dominguez 728*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1988. Pantropical weed, probably native to Asia; in the New World from the West Indies, western and southern Mexico to Nicaragua, and in Brazil.

Chenopodiaceae

****Chenopodium ambrosioides*** L., Sp. Pl. 219. 1753.

Distribution.—Locally common in bare areas, near km 6 on airport road, west of Cabo Pearce (*Moran 25517*), and north of Huerta Grande (*Moran 29531*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Weedy over most of temperate and tropical America, thought to be native from Mexico southward; introduced in the Old World. Called "epazote" and used as a condiment in Mexico and parts of Central America; possibly brought to Socorro intentionally.

Combretaceae

Conocarpus erecta L., Sp. Pl. 176. 1753.

Distribution.—Locally common along shore and on hillsides up to 100 m, northern part of island (Playa Blanca, Bahía Academy). Widely distributed on shores in tropical America, from Florida, Tamaulipas, and central Baja California to Ecuador and Brazil; Galápagos Islands; tropical West Africa.

Convolvulaceae

Key to Species

1. Plants silky-canescens; leaves sessile; corolla white, about 5 mm long *Cressa truxillensis*
1. Plants glabrous or essentially so; leaves petioled; corolla pink to purple, more than 1 cm long
 2. Leaves nearly orbicular, unlobed, the apex rounded or retuse; plants trailing and rooting at the nodes *Ipomoea pes-caprae*
 2. Leaves cordate, often 3-lobed; the apex acute; plants twining *Ipomoea triloba*

Cressa truxillensis Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 3:119. 1819.

Distribution.—Abundant about brackish pool at Bahía Academy (*Moran 5878*). Alkaline or saline soils from western United States south throughout Baja California and to central Mexico; South America.

Ipomoea pes-caprae (L.) Sweet subsp. ***brasiliensis*** (L.) Ooststr., Blumea 3:533. 1940.

Distribution.—Common on beaches around island (Bahía Academy, Playa Blanca, Caleta Grayson, Caleta Castelán). Circumtropical on beaches.

Ipomoea triloba L., Sp. Pl. 161. 1753.

Distribution.—Occasional in open and brushy places at least up to 250 m (Bahía Academy, along airport road at 250 m, Caleta Binner, Cabo Rule, north of Caleta Castelán). Southern Arizona, Florida, West Indies, southern Baja California through tropical America; naturalized throughout Old World tropics.

Cucurbitaceae

****Lagenaria siceraria*** (Molina) Standley, Publ. Field Mus. Nat. Hist., Bot. Ser. 3:435. 1930.

Distribution.—Roadside ca. 1 km southeast of Laguna Escondida (Moran 29543). Not previously reported for Socorro; a recent introduction, first collected there in 1981 after having escaped from cultivation at Huerta Grande. Native to the Old World but widely cultivated throughout the American tropics, often becoming naturalized.

Euphorbiaceae

Key to Species

1. Plants herbs or subshrubs; one carpellate flower and several staminate flowers enclosed in a cup-shaped gland-bearing involucre, the whole unit resembling a single flower
 2. Leaves alternate, symmetrical at base; stipules glandular *Euphorbia heterophylla*
 2. Leaves opposite, asymmetrical at base; stipules subulate, not glandular
 3. Leaves entire
 4. Plants herbaceous; stems glutinous, often covered with sand grains; involucres solitary in leaf axils *Chamaesyce incerta*
 4. Plants subshrubs; stems not glutinous; involucres crowded in dense glomerules *Chamaesyce anthonyi*
 3. Leaves toothed
 5. Herbage and capsules glabrous *Chamaesyce hyssopifolia*
 5. Herbage and capsules pubescent
 6. Stems with spreading yellowish hairs; involucres crowded in dense glomerules *Chamaesyce hirta*
 6. Stems with appressed white hairs; involucres few to several at nodes, but not in dense glomerules *Chamaesyce thymifolia*
 1. Plants well-developed shrubs or trees; flowers in spikes or racemes, not enclosed in a cup-shaped involucre
 7. Plants trees; leaves glabrous; fruit a 6–9-celled drupe *Hippomane mancinella*
 7. Plants shrubs; leaves pubescent; fruit a 3-celled capsule
 8. Pistillate flowers subtended by a foliaceous bract; pubescence simple *Acalypha umbrosa*
 8. Pistillate flowers not subtended by a foliaceous bract; pubescence stellate *Croton masonii*

Acalypha umbrosa T. S. Brandegee, Erythea 7:7. 1899.

Distribution.—Widespread in brushy places from shore to summit, often abundant. Endemic to Isla Socorro; type without exact locality, *Anthony* 375 (UC 110724).

Remarks.—Pax and Hoffmann (1924:124; 1931:130) assigned *A. umbrosa* to section *Cuspidatae*, which is mainly West Indian and South American. Standley (1923:630) and Johnston (1931:69) instead thought it closest to *A. californica* Benth., of southwestern California, Baja California, and northwestern Sonora, in section *Betulinae*. These sections are supposed to differ in their spikes: predominantly bisexual in *Cuspidatae*, unisexual in *Betulinae*. As Pax and Hoffmann pointed out, however, spikes may be unisexual or bisexual in both sections, the difference really being one of predominant condition. Johnston noted that in

A. umbrosa many spikes are bisexual, with a few carpellate flowers on the peduncle but otherwise staminate, and that some plants bear elongate, loosely flowered carpellate spikes. The many collections made since then show that most plants bear both carpellate spikes and bisexual spikes; most of these have only a few carpellate flowers at the base, but a few bear numerous carpellate flowers (e.g., *Moran* 5859); exclusively staminate spikes are rare. This condition appears to be more like that in section *Betulinae*, and *A. umbrosa* compares quite well with the American members of that section, all essentially restricted to Baja California. Final resolution of this problem awaits a modern revision of the genus.

Chamaesyce anthonyi (T. S. Brandegee) Levin, comb. nov. *Euphorbia anthonyi* T. S. Brandegee, Erythea 7:7. 1899.

Euphorbia clarionensis T. S. Brandegee, Erythea 7:7. 1899. *Euphorbia anthonyi* T. S. Brandegee var. *clarionensis* (T. S. Brandegee) I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:71. 1931. Type from Isla Clarión (*Anthony* 406).

Distribution.—Widespread in open and brushy places from shore to summit, often abundant. Endemic to the Revillagigedos; the type of *E. anthonyi* from Isla San Benedicto (*Anthony* 369).

Remarks.—At the shore this subshrub may be semiprostrate; inland it is arching to erect, to 4 dm tall, the stem to 1 cm thick at the base.

With this species, Brandegee described *E. clarionensis*, from Clarión. Johnston (1931:71) kept the plants of Clarión separate from those of San Benedicto and Socorro as *E. anthonyi* var. *clarionensis*, saying that they differed in having narrow white petaloid appendages to the involucreal glands. However, some plants from Socorro also have such appendages (e.g., *Moran* 5917). Therefore, we follow Standley (1923:602) in treating these as synonyms.

M. J. Huft (pers. comm.) thought *C. anthonyi* most closely related to *C. hypericifolia* (L.) Millsp. and *C. hyssopifolia* (L.) Small, both of which range from the southern United States to South America.

**Chamaesyce hirta* (L.) Millsp., Field Mus. Nat. Hist., Bot. Ser. 2:303. 1909, var. *hirta*. *Euphorbia hirta* L., Sp. Pl. 454. 1753.

Distribution.—Locally common in disturbed places, along road to Cerro Evermann trailhead at 350 m (*Levin* 2035), near airstrip (*León* 3515), at naval base (*Levin* 2029). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1988. Widespread weed of tropical America, ranging from the southeastern United States west to Arizona, south

through Mexico to Argentina; adventive in the Old World.

***Chamaesyce hyssopifolia** (L.) Small, Bull. New York Bot. Gard. 3:429. 1905. *Euphorbia hyssopifolia* L., Syst. Nat. ed. 10, 1048. 1759.

Distribution.—Common locally in roads, airport road between 190 and 250 m (Dominguez 710; León 3444; Levin 2032), northeast of Bahía Braithwaite (Levin 1778), Caleta Castelán near main landing (Moran 29495). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1981. Widespread weed of tropical America, ranging from Florida west to Arizona, south through Mexico to Argentina; adventive in the Old World.

Chamaesyce incerta (T. S. Brandegees) Millsp., Field Mus. Nat. Hist., Bot. Ser. 2:409. 1916. *Euphorbia incerta* T. S. Brandegees, Proc. Calif. Acad. Sci., ser. 2, 3:171. 1891.

Distribution.—Common with *Ipomoea pes-caprae* on upper beaches on north side of island (Bahía Academy, Playa Blanca). Sandy shores near La Paz, Baja California Sur, and from Bahía Kino, Sonora, to Mazatlán and Islas Tres Marías, Sinaloa (R. S. Felger, pers. comm.).

***Chamaesyce thymifolia** (L.) Millsp., Field Mus. Nat. Hist., Bot. Ser. 2:412. 1916. *Euphorbia thymifolia* L., Sp. Pl. 454. 1753.

Distribution.—Common weed at naval base, Cabo Rule (Moran 25438); uncommon near airstrip (Dominguez 723, León 3509). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Widespread weed of tropical America, ranging from Florida and the West Indies through Mexico to South America; adventive in the Old World.

Croton masonii I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:67. 1931.

Distribution.—Dominant and often forming pure stands on hillsides and alluvial fans near shore at south end, extending upward to about 250 m; abundant but less dominant at north end to about 150 m; on west side above Caleta Grayson scattered to at least 350 m. Endemic to Isla Socorro; type from "the east slope," Mason 1637 (CAS 186600). Mason evidently did not visit the lower east slope, however, and the type probably is from near Bahía Braithwaite.

Remarks.—This is a shrub 0.5–3.5 m tall, branching from the base, where the stem is 1–5 cm thick. The old leaves often turn a beautiful orange-red before falling.

Johnston (1931:68) thought the relationships of *C. masonii* obscure but perhaps closest to the widespread Mexican *C. cortesianus* Kunth. G. L. Webster, who is preparing a monograph on the Mexican crotons (pers. comm.), thought *C. masonii* a distinct species most closely related to *C. culiacanensis* Croizat, of Sinaloa, from which it differs conspicuously in its larger, coarser leaves with a different venation pattern.

***Euphorbia heterophylla** L., Sp. Pl. 453. 1753.

Distribution.—Few plants in disturbed soil, north of Bahía Braithwaite (Levin 1789). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Widespread weed of tropical America, ranging from Texas and Arizona through Mexico to South America.

Hippomane mancinella L., Sp. Pl. 1191. 1753.

Distribution.—Forming groves in sandy soil just behind beach on northern and western sides of island and growing as scattered shrubs on nearby hillsides up to 100 m (Bahía Academy, Playa Blanca, Caleta Grayson). Sandy beaches, southern Florida, West Indies, southern and western Mexico, to Colombia and Venezuela; Galápagos Islands.

Remarks.—The larger trees are about 8 m tall, with trunks sometimes 1.5 m thick.

Fabaceae

Key to Species

1. Leaves bipinnate
 2. Leaflets 1–2 cm wide; fruit more than 3 cm wide, prickly *Caesalpinia bonduc*
 2. Leaflets less than 7 mm wide; fruit less than 1.5 cm wide, not prickly
 3. Plants armed with paired white nodal spines 1–3 cm long *Acacia farnesiana*
 3. Plants unarmed, nodal spines absent
 4. Plants well-developed shrubs, woody throughout; leaflets 2–6.5 mm wide; petiole and rachis without a nectary gland *Zapoteca formosa*
 4. Plants herbs or subshrubs, woody only at base; leaflets less than 2 mm wide; petiole bearing a nectary gland at its middle or between the basal pinnae
 5. Fruit linear, 4–10 cm long and 3–4 mm wide, sessile *Desmanthus bicornutus*
 5. Fruit elliptic, 2.5–3.5 cm long and 7–11 mm wide, stipitate *Neptunia plena*
 1. Leaves simply pinnate
 6. Leaves even-pinnate, mostly with 3 pairs of leaflets; flowers somewhat bilateral but not pea-like; stamens free *Senna obtusifolia*
 6. Leaves odd-pinnate or palmate with 3 leaflets; flowers strongly bilateral and clearly pea-like; stamens all, or 9 of them, fused
 7. Leaves white-silky; lateral leaflets often lobed on outer side; fruit 6–10 cm long and 3–5 mm wide *Macroptilium atropurpureum*

7. Leaves green, not silky; lateral leaflets sometimes asymmetrical at base but never lobed; fruit less than 5 cm long or, if longer, then 1 cm or more wide
8. Fruit transversely divided between the seeds, breaking into 1-seeded segments, which are clothed with hooked hairs ... *Desmodium procumbens*
8. Fruit not transversely divided between the seeds, longitudinally dehiscent along both margins, not clothed with hooked hairs
9. Leaflets and calyx with yellowish gland-dots; fruit less than 2 cm long ... *Rhynchosia minima*
9. Leaflets and calyx not gland-dotted; fruit more than 2.5 cm long
10. Plants erect; stamens alternately longer and basifixed, shorter and dorsifixed ... *Crotalaria incana*
10. Plants prostrate or twining; stamens not dimorphic
11. Leaves orbicular, the apex rounded; fruit straight, more than 10 cm long and 2 cm wide ... *Canavalia rosea*
11. Leaves ovate to deltoid, the apex acute; fruit lunate, less than 6 cm long and 1.5 cm wide ... *Phaseolus lunatus*

***Acacia farnesiana** (L.) Willd., Sp. Pl. ed. 4:1083. 1806.

Distribution.—Abundant in arroyo north of Bahía Braithwaite (Levin 1771) and scattered along roadsides from there to the airstrip. Planted near Caleta Castelán. Not previously reported for Socorro and apparently a recent escape from cultivation. Southwestern United States and West Indies through Mexico to South America; introduced to Old World tropics.

Remarks.—This plant was first collected on Socorro in 1978, when Moran found it only where it had been planted near Caleta Castelán. In the subsequent 10 years it spread along the road all the way to the airstrip. Though it is spreading rapidly, it appears to be restricted to disturbed sites.

Caesalpinia bonduc (L.) Roxb., Fl. Ind. ed. 1832, 2:362.

1832. *Guilandina bonduc* L., Sp. Pl. 381. 1753; *op. cit.*, ed. 2, 545. 1762. pro parte.

Caesalpinia crista L., Sp. Pl. 380. 1753. pro parte.

Caesalpinia bonducella (L.) Fleming, Asiat. Res. 11:159. 1810.

Guilandina socorroensis Britton & Rose, N. Amer. Fl. 23:338. 1930. Type from Socorro without exact locality, *Barkelew* 207 (US).

Distribution.—Small colonies occasional in scrub in northern half of island, from shore to at least 550 m. Widespread in tropics and subtropics of both hemispheres, generally near the shore.

Although Britton and Rose attributed this plant to Socorro on the basis of *Barkelew* 207, Johnston (1931:14,63) thought *Barkelew*'s specimen probably came from Clarión instead. We believe it was indeed from Socorro; see discussion under Botanical Collectors. Whatever the source of the specimen, the plant grows on both islands.

Remarks.—This plant has usually been called *C. crista*, the name used by Johnston (1931:63), or *C. bonducella*. The correct name, according to Dandy and Exell (1937), is *C. bonduc* (L.) Roxb.

Canavalia rosea (Sw.) DC., Prodr. 2:404. 1825.

Canavalia maritima [Aublet] Thouars in Desv., J. Bot. 1:80. 1813.

Canavalia apiculata Piper, Contr. U.S. Natl. Herb. 20:566. 1925.

Distribution.—Common on shore at Cabo Middleton, the only place it has been collected, and probably elsewhere around the island. Pantropical on seacoasts.

Johnston (1931:64) reported that Mason had seen but not collected this plant at Caleta Grayson, and Miranda (1960:132) said it is found on berms in bays and coves. Though Moran looked for it in several places, he found it only on the bare west slope of Cabo Middleton at 50 m (*Moran* 25534). *Barkelew* 249, though labeled Socorro and so cited by Sauer (1964), is probably from Clarión, where the plant is known from other collections (see discussion under Botanical Collectors).

Remarks.—We follow Verdcourt (1971:576–577) in accepting *C. rosea* as the correct name for this species.

***Crotalaria incana** L., Sp. Pl. 716. 1753.

Distribution.—Common in disturbed areas north of Bahía Braithwaite (Levin 1761) and near naval base (*Dominguez* 750). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Widespread weed of tropical America, ranging from the southeastern United States and West Indies through Mexico to South America; introduced to Old World tropics.

***Desmanthus** cf. *bicornutus* S. Watson, Proc. Amer. Acad. Arts 21:426. 1886.

Distribution.—Uncommon along disturbed roadsides northeast of Bahía Braithwaite (Levin 1775). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Arizona and western Mexico, from Baja California, Sonora, and Chihuahua to Guerrero.

Remarks.—When collected in April 1987, all the plants were in fruit and bore only a few battered leaves. Without more complete material, identification of species in this complex is difficult.

***Desmodium procumbens** (Miller) A. Hitchc., Annual Rep. Missouri Bot. Gard. 4:76. 1893.

Distribution.—Uncommon in disturbed soil at roadsides, El Ranchito, north of Caleta Castelán (*Moran*

25527), northeast of Bahía Braithwaite (*Levin 1781*), near the naval base (*Dominguez 752*); in 1988, seen by Levin along roadsides to at least 215 m. Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Mexico from Sinaloa south, Central America, West Indies, northern South America, Galápagos Islands; introduced to tropical Africa and the Philippines.

****Macroptilium atropurpureum* (DC.) Urban, Symb. Antill. 9:457. 1928. *Phaseolus atropurpureus* DC., Prodr. 2:395. 1825.**

Distribution.—Uncommon near naval base at 15 m (*Dominguez 708*). Widespread from Texas through much of Mexico to Central and South America.

This is the first definite record of this species for Socorro. A specimen collected by Barkelew (248) is labeled “Socorro” but, as Johnston (1931:14) pointed out, probably came from Clarión (see discussion under Botanical Collectors). Because no one found this plant on Socorro between 1903 and 1988 and because it has been found only in a disturbed area, it would appear to be a recent arrival.

****Neptunia plena* (L.) Benth., J. Bot. (Hooker) 4:355. 1841.**

Distribution.—Common along disturbed roadsides near naval base (*Dominguez 740*; *Levin 2052*) and northeast of Bahía Braithwaite (*Levin 1776*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Coasts from the West Indies, southern Texas, southern Baja California, and Sinaloa to South America; India.

***Phaseolus lunatus* L., Sp. Pl. 724. 1753.**

Distribution.—Occasional on rocks and in brush on upper part of island, at least from 450 to 980 m. Known in its wild form from southern Mexico through Central America and in South America from Peru to Argentina.

***Rhynchosia minima* (L.) DC., Prodr. 2:385. 1825.**

Distribution.—Local on hillside at Bahía Academy (*Howell 8446*; *Moran 5908*); uncommon in disturbed areas north of Huerta Grande (*León 3435*) and north of Bahía Braithwaite (*Levin 1762*). Reported by Johnston (1931:65) from Socorro without definite locality on the basis of *Anthony s. n.* Grear (1978) cited Moran’s collection. Southern United States through Mexico to South America, possibly introduced from the Old World (Grear 1978). Though the plants in disturbed soil on the south side of the island might be introduced, those in undisturbed vegetation at the north end appear to be native.

****Senna obtusifolia* (L.) Irwin & Barneby, Mem. New York Bot. Gard. 35:252. 1982. *Cassia obtusifolia* L., Sp. Pl. 377. 1753.**

Distribution.—Common in disturbed area near naval base, 15 m (*Dominguez 746*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1988. Pantropical and subtropical weed, apparently native to the Americas, where it ranges from the southern United States and the West Indies through most of Mexico to Central and South America.

***Zapoteca formosa* (Kunth) H. Hern. subsp. *socorrensis* (I. M. Johnston) Levin, H. Hernández, & Moran, comb. nov. *Calliandra socorrensis* I. M. Johnston, Contr. Gray Herb. 70:71. 1924. *Anneslia socorrensis* (I. M. Johnston) Britton & Rose, N. Amer. Fl. 23:64. 1928.**

Calliandra sp. I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:63. 1931.

Distribution.—Occasional to locally common in scrub, Bahía Academy, 20–150 m; rare on upper east slope of Cerro Evermann. Endemic to islas Clarión and Socorro; type from Isla Socorro without exact locality, *Anthony s. n.* (UC 83534).

Amplified description.—Shrub 1–1.6 m high, the crown to 2 m wide. Trunk single for up to half its height (when shrubs crowded), to 6 cm thick above slightly enlarged base; bark gray, somewhat mottled. Branches numerous, terete, glabrous, reddish or yellowish when young, the internodes 0.5–2.5 cm long. Stipules 2–5 mm long, 1.5–2.5 mm wide, oblong-lanceolate, acute, 5–7-nerved, persistent. Leaves (1–)2–4-jugate, the petiole 1.5–2.5 cm long, the rachis 5–8 mm long, the petiole, rachis, and rachilla reddish when young; pinnae 1.5–4.0 cm long; leaflets 4–12 pairs, 5–15 mm long, 2.0–6.5 mm wide, oblong, obtuse at apex, obtuse and strongly oblique at base, membranous, faintly veined, sparsely ciliate but otherwise glabrous. Peduncles axillary, (1–)2–4 per axil, 2–3 cm long, slender, glabrous. Heads with 12–20 sessile ephemeral flowers. Calyx 2.0–2.5 mm long, the lobes about as long as tube and glandular-puberulent on backs and margins. Corolla 3.5–4.5 mm long, glabrous, the lobes a little shorter than tube and recurved, acute. Stamens numerous, 1.5–2.0 cm long, white. Legumes somewhat veiny and light to rather dark brown without, pale yellow within, 2.5–6.5 cm long, 6–10 mm wide. Seeds 2–9 per pod, the shape variable, commonly irregularly subquadrangular-lenticular with circumference subacute but sometimes (when adjacent ovules develop) with one end or two opposite ends truncate, 3.0–5.6 mm long, 3.0–4.5 mm wide, ca. 2.5 mm thick,

smooth and somewhat shining, mottled, each of the two main faces with a distinct brownish white pleurogram, the margins blackish (Figure 12).

Collections examined.—Isla Clarión: without exact locality, *Mason 1566* (CAS, GH); above Sulphur Bay, *Howell 8371* (CAS, GH). Isla Socorro: without exact locality, *Anthony s. n.* (two sheets: UC 83534, the holotype, and UC 89257); ridge south of Bahía Academy, 20 m, *Moran 5902* (ENCB, SD); locally common, flat top of ridge west of Bahía Academy, 90 m, *Moran 25546* (ARIZ, BISH, BM, CAS, CIB, ENCB, F, GH, MEXU, MICH, MO, NY, RSA, SBBG, SD, TEX, US); same, grown from seed and flowering in San Diego (MEXU, SD); same, grown from seed and flowering at Huntington Botanical Garden (SD); near summit of island, *Mason 1661* (CAS); few locally, east slope of Cerro Evermann, 980 m, *Moran 5841* (SD, US); near summit of Cerro Evermann, *Miranda 8732* (MEXU).

Remarks.—Johnston (1931:62–63), working with a

few fruiting specimens only, recognized two species of *Calliandra* from the Revillagigedos, differing in number of pinnae and number and size of leaflets. He considered both weak species, the first, *C. socorrensis*, close to *C. formosa* (Kunth) Benth. of western Mexico, and the second, an unnamed species, possibly close to *C. portoricensis* (Jacq.) Benth. of the West Indies and southeastern Mexico.

Hernández (1986) recognized *Calliandra* series *Laetevirentes* Benth., which includes *C. formosa* and *C. portoricensis*, as a new genus, *Zapoteca*, on the basis of differences in pollen, seedling morphology, chromosome numbers, and reproductive features. He (Hernández in press) studied all the Socorro and Clarión specimens Johnston had seen and two more fruiting collections, and called them all *Zapoteca formosa* subsp. *rosei* (Wiggins) H. Hern., which ranges from southern Baja California and northern Sonora to Oaxaca. Moran's three collections, which Hernández had not seen, fall within the range of variation of the other Revillagigedos collections.

Three shrubs, grown from seeds of *Moran 25546* by B. Knerr at the San Diego Zoo (one subsequently transplanted to Huntington Botanical Garden, San Marino, California), flowered in late September and October of 1980 and following years, allowing us to describe the flowers of *Z. formosa* subsp. *socorrensis* for the first time. In most respects the Socorro plant seems much like *Z. formosa rosei*, as Hernández recognized. *Z. formosa socorrensis* has white filaments, however, whereas *Z. formosa rosei* has filaments that are white below and red to pink or purple above. Also, the leaves of *Z. formosa socorrensis* are oblong and often smaller than the obovate or oblong-obovate leaves of *Z. formosa rosei*. Thus it seems best to treat *Z. formosa socorrensis* as an endemic subspecies. In cultivation the flowers of *Z. formosa socorrensis* are diurnal, though short-lived. If they are diurnal in the wild, *Z. formosa socorrensis* is unique in the genus; all other species of *Zapoteca* have nocturnal flowers (Hernández 1986).

Gentianaceae

Key to Species

1. Corollas deep pink within, 10–16 mm long; leaf apices blunt *Centaurium capense*
1. Corollas light pink within, 8–10 mm long; leaf apices mucronate *Centaurium wigginsii*

Centaurium capense Broome, Madroño 24:241. 1977.

Distribution.—Widely scattered in openings in low vegetation, east slope of Cerro Evermann at 900–1000 m (*Moran 5849* (in part), 29519), not as common as the following. Not previously reported for Socorro.



Fig. 12. Flowering branch of *Zapoteca formosa* subsp. *socorrensis*. Grown in San Diego from seed of *Moran 25546*. Scale bar equals 1 cm.

Southern Baja California, in the Sierra de la Giganta and the Cape region.

Centaurium wigginsii Broome, Madroño 24:239. 1977.

Distribution.—Common in low vegetation, east slope of Cerro Evermann at 950–1040 m (*Felger 15765*; *Levin 1816*; *Moran 5849* (in part), 29506). Not previously reported for Socorro. Sierra Madre Occidental of Durango and Nayarit.

Remarks.—The corolla opens in the morning and closes by midafternoon.

Broome (1977) described this species as closest to *C. strictum* (Schiede) Druce of the Nueva Galicia region of western Mexico, differing in its divaricate branches, fewer and less conspicuous bracts, longer pedicels, and other respects. Most of the Socorro specimens, however, have much less divaricate branches, leafier stems, and shorter pedicels than shown in the original figure.

Goodeniaceae

Scaevola plumieri (L.) Vahl, Symb. Bot. 2:36. 1791.

Distribution.—Locally common with *Ipomoea* and *Jouvea* on tombolo (spit) connecting Cabo Henslow with the main island and separating Caleta Trueno on the west from Playa Blanca (*Felger 15778*; *Moran 25467*); not on inner beaches of Playa Blanca. Beaches throughout the tropics of both hemispheres; on the Pacific coast of Mexico north to southern Baja California.

Brandege (1900b) reported this plant from Socorro on the basis of *Anthony 387*, but since that specimen is labeled Clarión, Johnston (1931:98) thought the report erroneous. Although the number alone is not decisive, it does fall with those from Socorro (375–401) rather than with those from Clarión (403–417); see discussion under Botanical Collectors. Furthermore, Brandege obviously could have had information directly from the collector, though if he did, it is strange that he did not correct the label of the specimen in his own herbarium. Because the plant is now known to occur on Socorro and apparently has not since been collected on Clarión, we are now inclined to accept Brandege's report rather than the label locality.

Hypericaceae

Hypericum eastwoodianum I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:78. 1931.

Distribution.—Occasional in rocky places from shore to summit, more common in upper half of island. Endemic to Isla Socorro; type from cliff-faces at Caleta Grayson, *Mason 1614* (CAS 186606).

Remarks.—This is a shrub 2–7 dm tall, with fragrant foliage.

Johnston (1931:79) said that the exact relationships of this species were obscure but probably were in southern Mexico or South America. Eastwood (1943) has since described the related *H. peninsulare* from the mountains of the Cape region of Baja California. These two species are very similar, supposedly differing in sepal size and shape, capsule length, and stamen number. Collections of *H. eastwoodianum* made since Johnston's description show that the two species overlap in the sepal and capsule characters but that *H. eastwoodianum* is somewhat more shrubby than *H. peninsulare*.

Lamiaceae

Key to Species

1. Calyx strongly bilabiate, the upper lip with 1 tooth or blunt, the lower lip with 2 teeth; stamens 2; anther connectives elongate and articulating with the filament
2. Plants suffrutescent; corolla light blue; anther connectives straight, with a small tooth on the upper side near the middle; upper calyx lip rounded to retuse with mucro short to subobsolete . . . *Salvia pseudomisella*
2. Plants strictly herbaceous; corolla dark blue; anther connectives abruptly bent upward, not toothed; upper calyx lip clearly mucronate . . . *Salvia riparia*
1. Calyx not bilabiate, with 5 nearly equal teeth; stamens 4; anther connectives not elongate
3. Plants annual herbs; flowers small, the calyx ca. 3 mm long and the corolla ca. 4 mm long . . . *Hyptis pectinata*
3. Plants perennial herbs or weak shrubs; flowers larger, the calyx at least 5 mm long and the corolla at least 1 cm long
4. Leaves cinereous, hastate, serrate; inflorescence a cymose panicle . . . *Lepechinia hastata*
4. Leaves glabrous, elliptic, attenuate at base, entire or nearly so; flowers solitary in axils of upper leaves . . . *Teucrium townsendii*

****Hyptis pectinata*** (L.) Poit., Ann. Mus. Natl. Hist. Nat. 7:474, t. 30. 1806.

Distribution.—Common on disturbed roadsides, as along road to Cerro Evermann trailhead at 350 m (*Levin 2033*) and along arroyo, Caleta Castelán near main landing (*Moran 25442*, 29491); also one large plant on broken lava, northeast of Bahía Braithwaite (*Levin 1786*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Common weed in tropical America.

Lepechinia hastata (A. Gray) Epling subsp. *socorrensis* Moran, subsp. nov. (Figure 13)

Type.—Isla Socorro, Mexico: with low vegetation at 700 m on the rocky upper south slope of the peak south of Cerro Evermann, near 18°45.5'N, 110°57.75'W, 11 March 1957, *Moran 5780* (Holotype: SD 49466; isotypes: CAS, MEXU, US).

Frutex statu sterili fere 3–5 dm altus. Folia cinerea, laminis 3–13 cm longis 1–8 cm latis. Corolla alba, tubo 9–11 mm longo. Typus: *Moran 5780* (SD 49466). A subspecie typica foliis minoribus corollaque alba minore differt.



Fig. 13. Holotype of *Lepechinia hastata* subsp. *socorrensis*.

Low malodorous shrub, commonly 3–5 dm tall when not in flower. Rootcrown to 2.5 cm thick, the branches 3–6 mm thick at base, with internodes 0.5–6 cm long. Leaves cinereous, the blades sagittate to hastate, 3–13 cm long, 1–8 cm wide, the petioles 1–4 cm long. Floral stems 2–12 dm tall, the inflorescence 12–20 cm long, 4–8 cm wide. Pedicels 2–4 mm long. Calyx tube at anthesis 2–3 mm long, in fruit 5–6 mm long, the lobes 2–3.5 mm long, scarcely increasing in fruit. Corolla white, the tube (6–)9–11 mm long, the upper lip 3–4 mm long. Stamens exerted 2–6 mm from throat. Nutlets black, smooth, \pm obovoid, ca. 1.1–2.7 mm long and 0.7–1.8 mm wide.

Paratypes.—South slope of Cerro Evermann at 1030 m, *Moran 5820* (SD); openings in forest near the summit, *Mason 1658* (CAS); lava on southeast flank of Cerro Evermann at 800 m, *Moran 25505* (SD); south slope at 800 m, *Felger 15769* (ARIZ, SD); at 700 m, *Miranda 8711* (MEXU, SD); south slope at 600 m, *Felger 15795* (ARIZ, BISH, ENCB, RSA, SD); talus southeast of Cerro Evermann at 550 m, *Moran 5774* (CIB, K, MO, NY, SD, UC); bare soil in the caldera valley southeast of Cerro Evermann at 550 m, *Moran 5758* (SD); near laguna [probably Laguna Escondida] south-southeast of Cerro Evermann at 150–200 m, *Miranda 8726* (MEXU, SD); Socorro Island without exact locality, *Barkeley 234* (UC).

Distribution.—Endemic to Isla Socorro. Rather common on upper half of south slope of island, especially in rocky places with low vegetation, where it may be dominant. Because the plant is still fairly abundant in some places that the sheep have nearly denuded of low vegetation, apparently it is distasteful to them.

Flowering time.—In March and April most plants were sterile, only a few collections being taken in flower. Miranda's two collections of January 1958 are both in flower, as is *Dominguez 698*, collected in September 1988. Levin saw it in bloom in December 1988 but did not collect it.

Remarks.—The species was described from the mountains of Maui, in the Hawaiian Islands, and later was found to be common in the mountains of the Cape region of Baja California. Johnston (1931:90) reported "very mature material of what certainly seems to be this species" (*Mason 1658*) from Socorro, and Epling (1948) agreed. Now flowering material shows that the plant of Isla Socorro differs from typical *L. hastata* of Maui and the Cape region in its white rather than purplish red corolla, in its densely tomentose and hence often grayer herbage, and in the generally smaller size of its leaves, inflorescence, and floral parts. Its leaves are conspicuously grayer than those of plants from the

Cape region; plants of Maui vary in amount and color of pubescence, some being similar to those of Socorro, some having less pubescence, and some being rusty. In exposed rocky places it tends to be relatively small: in the six sheets of *Moran 5774*, all leaves are smaller than 8 by 3 cm. Comparable measurements for the typical subspecies are as follows: internodes commonly 4–14 cm long, those few specimens that include the base of the plant having also 3 or 4 shorter ones; leaf blades 6–27 cm long, 2–15 cm wide; inflorescence mostly 2–3.5 dm long, 4–11 cm wide; calyx tube at anthesis 2–4 mm long, in fruit to 8 mm long, the lobes 3–6 mm long; corolla tube 11–21 mm long, the upper lip 4–8 mm long.

Photographs suggest that some plants of Socorro may be larger than the specimens cited, on which the description necessarily was based, and hence that the overlap in size between the two subspecies may be greater than their descriptions imply. It should also be pointed out that these comparisons are not entirely of corresponding parts: most of the specimens from Socorro are sterile, whereas those that we have seen from the other two areas have no sterile branches.

***Salvia pseudomisella* Moran & Levin, sp. nov.** (Figures 14 and 15)

Type.—Isla Socorro, Mexico: occasional in low vegetation at 950 m on east slope near summit of Cerro Evermann, near 18°46.5'N, 110°57.5'W, 5 April 1981, *Moran 29522* (Holotype: SD 118729; isotypes: ARIZ, BISH, BM, CAS, ENCB, F, GH, MEXU, MO, NY, RSA, SBBG, TEX, UC, US).

Suffrutex laxa ramosus 3–5 dm altus pilis deorsum curvatis sparse pubescens. Folia ovata acuta serrata basi obtusa 1.5–3.5 cm longa 1–2 cm lata, petiolis 0.5–1.0 cm longis. Inflorescentiae laterales et terminales interrupte spicatae graciles 5–10 cm longae, verticillastris 1–4-floratis, bracteis late ovatis 2–3 mm longis, pedicellis 1–2 mm longis. Calyx ovato-cylindricus extus hispidoglandulosus sub anthesi 2–3 demum 3.5–5.0 mm longus, labio superiore rotundato retusove submucronato, inferiore bilobato, lobis ovatis spinuloso-acuminatis. Corolla caerulea extus labiis glanduloso-pubescentibus exceptis glabra, tubo 2.0–2.5 mm longo, labio superiore 1.0–1.5 mm longo concavo, inferiore 2.0–2.5 mm longo. Stamina in galea inclusa, gubernaculo recto in medio minute dentato. Stylus glaber, ramis subaequalibus, postico acuminato, antico concavo rotundato. Typus: *Moran 29522* (SD 118729). Species *S. misellae* affinis sed habitu perenni, calycis labio superiori brevior mucronato, et gubernaculo recto differt.

Plant suffrutescent, diffusely branched, especially near base, 3–5 dm tall, thinly hirtellous below with coarse downward-curling hairs, thinly hirtellous and sparsely glandular in inflorescence with fine spreading or downward-curling glandless hairs and fine spreading gland-tipped hairs. Stems spreading to almost erect, woody and up to 5 mm thick near base, herbaceous and 1.5–2.5 mm thick through most their length. Leaves ovate, 1.5–3.5 cm long, 1–2 cm broad, acute, obtuse to



Fig. 14. Holotype of *Salvia pseudomisella*.

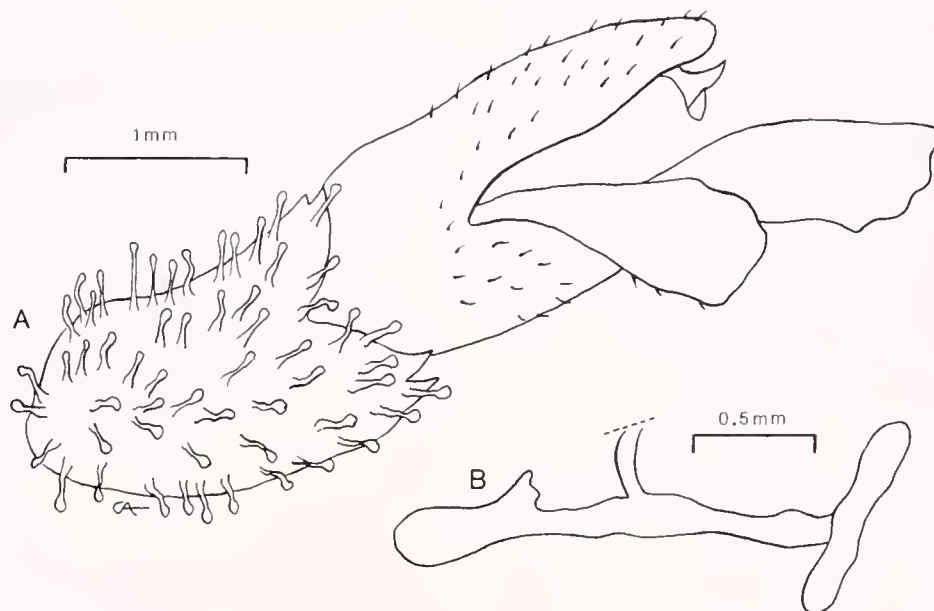


Fig. 15. *Salvia pseudomisella*. A, flower (Moran 29522, the holotype); B, stamen (Moran 5814).

truncate at base, decurrent on petiole 0.5–1.0 cm long, the margin coarsely serrate, both surfaces sparsely hirtellous with hairs like those on stem. Inflorescence a slender interrupted spike 5–10 cm long, lateral or terminal; verticels 1–4-flowered, subtended by persistent broadly ovate bracts 2–3 mm long. Flowering calyx ovate-cylindric, 2–3 mm long, glandular-hispid with stout gland-tipped hairs, the lips yawning, the upper lip rounded to retuse with very short to subobsolete mucro, the lobes of lower lip ovate and tipped with short spine; fruiting calyx 3.5–5.0 mm long, borne on pedicel 1–2 mm long. Corolla light blue, the tube 2.0–2.5 mm long, the lips glandular pubescent externally, the upper lip galeate, 1.0–1.5 mm long, the lower lip 2.0–2.5 mm long. Stamens included in galea, the connective almost straight, bearing small upward-pointing tooth near middle of lower branch. Style glabrous, the branches subequal, the upper attenuate, the lower concave and rounded. Nutlets elliptic, ca. 1.5 mm long and 1 mm broad, smooth, mottled dark brown on tan.

Paratypes.—Pedregal northeast of Cerro Evermann at 700–800 m, *Miranda 8754* (MEXU, SD); south slope of Cerro Evermann at 1030 m, *Moran 5814* (SD, UC); brushy arroyo on southwest slope of Cerro Evermann at 1020 m, *Moran 29510* (SD); along trail up south [actually east at that elevation] side of Cerro Evermann at ca. 800 m, *Felger 15826* (ARIZ, CIB, SD, UC); ridge south of Cerro Evermann just below fog forest, *Carlquist 355* (RSA); pedregal, south slope at 600 m, *Miranda 8720* (MEXU).

Distribution.—Endemic to Isla Socorro. Occasional above 600 m, more frequent toward summit.

Relationships.—On the basis of Carlquist's collection, which now lacks flowers, Epling and Mathias (1957) reported this plant as *Salvia misella* Kunth, a species widespread in Mexico and the Caribbean. Indeed, it is very similar to *S. misella*, especially to some specimens from southern Mexico. However, *S. pseudomisella* differs as follows: (1) The plant is perennial and somewhat woody at base, whereas *Salvia misella* is annual. (2) The upper lip of the calyx is rounded to retuse with the mucro short to subobsolete, whereas in typical *S. misella* the upper lip is rounded and mucronate, though there is some variation. (3) The two lobes of the lower calyx lip are less markedly asymmetric, with their anterior margins more and their posterior margins less curved. (4) The connective is almost straight, though with a small tooth near the middle of the lower branch, whereas in *S. misella* the connective is strongly geniculate, much as Epling (1939: fig. 2) showed for *S. riparia* Kunth.

The first three differences are relatively minor, but the fourth may be more important. In Epling's (1939) treatment, the form of the connective would exclude *S. pseudomisella* from section *Microsphace*, in which he placed *S. misella*. Yet the two plants agree closely in many characters of habit and foliage and of general form, nervation, and vestiture of the calyx. In both plants the upper calyx lip is 7-nerved rather than 5-nerved as stated by Epling (1939) for the section

Microsphace. The overall similarity is so striking that a close relationship seems probable.

**Salvia riparia* Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 2:300. 1817.

Distribution.—Uncommon in disturbed areas in the south side of island, as near the airstrip (*Dominguez* 727; *León* 3506), near Huerta Grande (*Moran* 29536), and on roadsides northeast of Bahía Braithwaite (*Levin* 1779). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1981. Common weed from the West Indies and northern Mexico to Peru.

Teucrium townsendii Vasey & Rose subsp. *affine* (T. S. Brandege) Moran, comb. nov. *Teucrium affine* T. S. Brandege, *Erythea* 7:6. 1899.

Distribution.—Occasional in brush at low elevations near north end (Bahía Academy, Playa Blanca) and on east side (southwest of Cabo Pearce). Endemic to Isla Socorro; type without exact locality, *Anthony* 385 (UC 122497). Anthony's number suggests that his specimen may have come from the southwest coast, but this is uncertain.

Remarks.—The collections of Moran (5898, 25473, 25542) and Felger (15793) allow us to amplify or correct the description of subspecies *affine* as follows: rootcrown to 1 cm thick; stems erect or arching, 1.5–4.5 dm long, dying back nearly to base; leaves elliptic, mostly entire but sometimes with 1–3 blunt teeth on each margin in upper half, the lower and middle leaves 2–4.5 cm long, 6–13 mm wide, the ratio of width to length ca. 0.23–0.32; calyx tube at anthesis 1.5–2 mm long, the lobes at anthesis 3.5–4.5 mm long, later to 7 mm long; corolla pale lavender marked with purple, 9–12 mm long, the lower lip 5–8 mm long; longer stamens 10–11 mm long; nutlets hairy at apex.

Subspecific relationships.—Johnston (1931:90) kept *Teucrium affine*, of Socorro, and *T. affine* var. *dentosum* I. M. Johnston, of San Benedicto, separate from *T. townsendii*, of Clarión, saying, however, that they were insufficiently known and should perhaps be treated as varieties. McClintock and Epling (1946) did not distinguish *T. affine* or *T. affine dentosum* even varietally.

Johnston said that *T. affine* differed from *T. townsendii* in its generally more slender and loosely branched habit, in its more slender and elongate leaves, and in its perhaps slightly smaller and less rugose nutlets, whose summits bore longer and more conspicuous trichomes. Table 2 of McClintock and Epling (1946) shows the differences mentioned by Johnston in width of leaves and hairiness of nutlets. Thus even though McClintock and Epling did not recognize *T. affine*,

their data show differences between the populations of the two islands. Furthermore, they said that their data suggested a difference in corolla size: in four collections from Clarión the corolla length was 10 to 15 mm and the length of the lower lip 6 to 10 mm, whereas in two collections from Socorro the corolla length was 8 to 11 mm and the length of the lower lip 5 to 7 mm. On the basis of more recent collections, the ranges of these two lengths can be slightly broadened for the plants of Socorro; however, the ranges for the plants of the two islands, though overlapping, still are quite different. Finally, there appears to be a difference in flower color: in collections from Socorro the corolla was pale lavender spotted with purple, whereas for his two collections from Clarión (*Mason* 1573, 1583) Mason noted that the flowers were white.

There still is not enough herbarium material for a thorough comparison of the populations of the two islands. The new material that is slowly accumulating always seems to fall into the old pattern, however, emphasizing that the populations are different even though the differences may be slight and some of the characters overlapping. Taxonomic distinction therefore seems appropriate.

Johnston separated plants from San Benedicto as *T. affine* var. *dentosum*. Herbarium material still is inadequate for placement of this plant. Quite possibly it should be another subspecies. It appears to be extinct, however, destroyed by the eruption of Volcán Bárcena in 1952 (Brattstrom 1963).

Relationships to other species.—Johnston thought *T. townsendii* clearly an insular derivative of *T. cubense* Jacq., of the southwestern United States, Mexico, and the Caribbean. McClintock and Epling (1946), in contrast, thought it closer to *T. bicolor* Smith, of Chile, saying in fact that certain specimens of *T. townsendii* could almost be mistaken for *T. bicolor*. By McClintock and Epling's key to the species, however, many specimens from the Revillagigedos would be identified as *T. cubense*. McClintock and Epling stressed the ratio of calyx teeth to tube: "The calyces of *T. bicolor*, *T. nudicaule*, and *T. townsendii-affine* are unique in proportions in the New World. This fact alone suggests a common alliance and origin." They described *T. townsendii* at anthesis as having calyx teeth the same length as the tube or slightly longer and placed it in their key with *T. bicolor* and *T. nudicaule* Hook. under the heading "Calyx teeth deltoid, approximately as long as the tube," whereas they placed *T. cubense* and *T. laciniatum* Torrey under the heading "Calyx teeth deltoid-lanceolate, definitely longer than the tube, or if subequal. . . ." However, their Table 2 shows that the

calyx teeth of *T. townsendii* vary from 1 to 2.5 times as long as the tube. In Howell's collection (8440) from Bahía Academy, the calyx teeth about equal the tube, but in *Moran 5898* and *25542* from the same locality the teeth are regularly twice as long as the tube or more, as they are in *Felger 15793* and *Moran 25473* from Playa Blanca. Furthermore, the nutlets of both *T. cubense* and *T. townsendii* are pitted or grooved, whereas those of *T. bicolor* and *T. nudicaule* are smooth (McClintock and Epling 1946). Thus it appears that *T. townsendii* is more closely related to *T. cubense*, as Johnston suggested.

Malvaceae

Key to Species

1. Fruit a capsule; carpels 3–5
 2. Involucel of 3 bracts; seeds pubescent
 3. Leaves deeply 5-parted, the lobes narrowly lanceolate; capsule pitted, 1.5 cm long; bracts of involucel 1.5–2 cm long *Gossypium lanceolatum*
 3. Leaves weakly 3–5-lobed, the lobes broadly triangular to ovate; capsule smooth, 2–5 cm long; bracts of involucel 2–4.5 cm long *Gossypium hirsutum*
 2. Involucel of 8–20 bracts; seeds glabrous
 4. Corolla yellow with a maroon center; leaves, pedicels, bracts, and calyx hispid; inflorescence a nearly leafless raceme *Hibiscus diversifolius*
 4. Corolla bright yellow throughout; leaves, pedicels, bracts, and calyx softly pubescent; flowers solitary in the leaf axils *Hibiscus pernambucensis*
1. Fruit schizocarpic, splitting into separate mericarps; carpels 5 or more
 5. Carpels 5; styles and stigmas 10; involucel of 5 bracts *Pavonia hastata*
 5. Carpels 5 or more; styles and stigmas as many as the carpels; involucel of 3 bracts or absent
 6. Involucel of 3 bracts; mericarps horseshoe-shaped with a prominent ventral notch
 7. Flowers solitary in the axils, scattered along the stems, on pedicels 2–10 mm long; hairs of upper leaf surface simple *Malvastrum coromandelianum*
 7. Flowers in a terminal spike; pedicels less than 2 mm long; hairs of upper leaf surface stellate *Malvastrum americanum*
 6. Involucel absent; mericarps not horseshoe-shaped
 8. Calyx much shorter than the fruits, which are 12–15 mm long and 10–13 mm wide; mericarps apically acuminate but without spines, 3-seeded *Abutilon californicum*
 8. Calyx about as long as fruits, which are less than 5 mm long and 5 mm wide; mericarps with 2 spines at apex, 1-seeded
 9. Inflorescence a compact panicle; leaves cordate or truncate at base; carpels 5 *Sida nesogena*
 9. Flowers solitary in leaf axils; leaves obtuse to acute at base; carpels often more than 5
 10. Leaves lanceolate to elliptic, serrate to base; carpels 5–8; flowers often congested toward the branch ends *Sida salviifolia*
 10. Leaves rhombic, entire in the lower third; carpels 10–14; flowers scattered along the stems, not congested toward the ends *Sida rhombifolia*

Abutilon californicum Benth., Bot. Voy. Sulphur 8. 1844.

Distribution.—Occasional in *Croton* scrub at low elevations near south end (Caleta Binner, Caleta Castelán, Bahía Braithwaite, near airstrip). Southwest United States, Baja California, Sonora.

Remarks.—On Socorro this species has denser pubescence, more prominent leaf serration (Fryxell 1988), and more compact inflorescences (P. A. Fryxell, pers. comm.) than it does on the mainland.

Gossypium hirsutum L., Sp. Pl. ed. 2. 975. 1763.

Distribution.—Small population at 10–20 m by south-east bay, Bahía Academy (*Moran 5907, 25541*); without exact locality (*Anthony s. n.*). This sparsely linted perennial ancestral form of the species grows in littoral habitats around the Gulf of Mexico and the Caribbean Sea and throughout the Pacific Ocean (Marquesas, Samoa, Tahiti, Wake Island, and northern Australia; Fryxell 1978:143–144, 171–173); its seeds float and survive long immersion in sea water (Stephens 1966, Fryxell 1978:143–147). Fryxell and Moran (1963) described and illustrated the Socorro plant and argued that it is native to the island.

***Gossypium lanceolatum** Tod., Relaz. 185. 1877.

Gossypium palmeri G. Watt, Wild and Cult. Cotton Plants 204, pl. 34. 1907.

Distribution.—In arroyo, Caleta Castelán near main landing. Evidently a recent introduction, plants were common when the species was first collected on Socorro in 1978, but only a few were seen in 1981. Native to Mexico, principally in dooryard cultivation (Fryxell 1978:68, 1988).

Hibiscus diversifolius Jacq., Collectanea 2:307. 1788 [1789].

Distribution.—Local near summit of island, above *solfataras* and down the slope to the northeast. West Indies and Central and South America, sometimes thought to be introduced from the Old World (Kearney 1955). The occurrence near the summit of Socorro would appear to be native, however.

***Hibiscus pernambucensis** Arruda, Diss. Pl. Brazil. 44. 1810.

Distribution.—Dense thickets on upper beach and lower north slope at Playa Blanca and first cove to east. Coastal Mexico from Nayarit and Tamaulipas south, the West Indies, to South America.

Remarks.—This tree, first collected on Socorro in 1967, appears to be a recent arrival. Admittedly, we do not know that earlier collectors visited Playa Blanca without finding it. However, because he collected *Scaevola plumieri*, known no place else on the island,

Anthony very likely visited Playa Blanca in 1897. He could scarcely have missed *H. pernambucensis* had it been there then. In 1978 Moran found several large new colonies of the hibiscus on hillsides 2–3 km east of Playa Blanca. Thus, though local on the island, it appears to be spreading aggressively. Had it done so for long, it would not still be local. These two lines of evidence strongly suggest that *H. pernambucensis* is a recent arrival.

The question remains how *H. pernambucensis* got to Socorro. Its wide littoral distribution must result from floating seeds, as do those of its Old World sibling species, *H. tiliaceus* L. (Merrill 1920; Carlquist 1974:472). Thus Socorro would seem a natural place for it to be native. Considering the long time it must have been dispersing, however, it seems most unlikely to have reached Socorro by natural means for the first time only recently, just when people began regularly visiting the island. Someone planted coconut palms at Playa Blanca, a well-protected white-sand beach used for swimming, and quite possibly planted the hibiscus as well. Whether or not it was planted intentionally, we suppose that it must have reached the island with human assistance.

Following Fryxell (1988) we treat *H. pernambucensis* as a New World species distinct from the Old World *H. tiliaceus* L.

***Malvastrum americanum** (L.) Torrey in Emory, Rep. U.S. Mex. Bound. 2(1):38. 1859.

Distribution.—Common weed in disturbed places in the south side of island, from shore up to at least 350 m. First collected on Socorro in 1978. Pantropical weed, in western Mexico from Sinaloa to Chiapas.

***Malvastrum coromandelianum** (L.) Garcke, Bonplandia 5:297. 1857.

Distribution.—Uncommon weed in disturbed places on the south side of island, as at airport road at 180 m and at El Ranchito, north of Caleta Castelán. First collected on Socorro in 1967. Pantropical weed, widespread in Mexico.

Pavonia hastata Cav., Diss. 3:138, t. 47, f. 2. 1787.

Distribution.—Occasional up to at least 230 m on ridge south of Bahía Academy. Widespread and common in South America; also found in the south-eastern United States, Tamaulipas, and southeastern Australia.

Remarks.—Kearney (1954) listed *P. nepetifolia* (Standley) Standley from Socorro, citing *Mason & Hanna 14619*, but said this species and *P. hastata* are very similar, if not identical. P. A. Fryxell (pers. comm.) found that true *P. nepetifolia* is yellow-flowered,

whereas *P. hastata* is purple-flowered. He (Fryxell 1988) cited both *Mason & Hanna 14619* and *Moran 5858* from Socorro.

Sida nesogena I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:96. 1931.

Distribution.—Occasional at low elevations around the island (Bahía Academy, Playa Blanca, Caleta Grayson, Caleta Castelán); grows also on a cliff near the summit of Cerro Evermann. Endemic to Isla Socorro; type from hills above Caleta Grayson at 160 m, *Mason 1613* (CAS 186605).

Remarks.—Fryxell (1985, 1988) thought *S. nesogena* most closely related to *S. glabra* Miller (including *S. glutinosa* Cav. and *S. alamosana* S. Watson ex Rose), a variable species of the West Indies and Mexico (Sonora and Baja California south) to South America; it is also in parts of the Old World. The distinction between the species is not well marked: among other features, *S. nesogena* differs in having denser pubescence and more congested inflorescences (Fryxell 1988).

Sida rhombifolia L., Sp. Pl. 684. 1753.

Distribution.—Widespread on south side of island from shore to summit, but uncommon. Southern United States through tropical America and in Old World tropics.

***Sida salviifolia** C. Presl, Reliq. Haenk. 2:110. 1835.

Distribution.—Scarce in weedy area, El Ranchito, north of Bahía Castelán. First collected on Socorro in 1978. West Indies and Mexico to northern South America.

Molluginaceae

Key to Species

1. Plants finely stellate-tomentose; seeds strophiolate *Glinus radiatus*
1. Plants glabrous; seeds not strophiolate ... *Mollugo verticillata*

Glinus radiatus (Ruíz Lopez & Pavón) Rohrb. in Martius, Fl. Bras. 142:238. 1872.

Distribution.—Abundant on dried mud, east shore of Laguna Escondida, 310 m (*Moran 29540*). Not previously reported for Socorro. Texas, Mexico, West Indies, to South America.

Remarks.—On 17 January 1958 Miranda, according to his field notes, visited a “Laguna el Rodeo” south-southeast of Cerro Evermann at 150–200 m—apparently the same place now called Laguna Escondida. His failure to collect this plant suggests that it may not have been in evidence at that season. In 1981, Moran collected large, old plants in March, later in the dry season, so Miranda simply might have overlooked

young plants. Alternatively, this species could be a later arrival on the island.

***Mollugo verticillata** L., Sp. Pl. 89. 1753.

Distribution.—Occasional at roadsides along airport road at 250 m (*León 3455*) and north of Caleta Castelán (*Moran 25524*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Widespread weed in the Americas, believed native to tropical America.

Moraceae

Ficus cotinifolia Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 2:49. 1817.

Distribution.—Occasional to common in arroyos at low elevations (Bahía Academy, Playa Blanca, Caleta Binner) and common to dominant in forest at middle elevations to 825 m. Sonora and Chihuahua to Costa Rica.

Remarks.—This tree is often 8 m tall and may have a spread of 20 m and a main trunk 7 dm thick; the bark is smooth and pale gray. The leaves appear to be much less pubescent beneath than in most mainland populations of the species.

Myrtaceae

Psidium socorrense I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:81. 1931.

Distribution.—Abundant in pure open stands on [summit?] plateau, seemingly confined to level areas, according to Mason as quoted by Johnston (1931:82). Known only from the type collection from the east slope, *Mason 1639* (CAS 186614). Mason's field book gives no clue to the elevation at which he collected the type. Apparently he numbered the specimens afterwards and not chronologically. It appears from his notes that by "the plateau" he meant what we are calling the summit plateau.

Remarks.—Johnston described this as a shrub 3–12 feet tall, with leaves 4–5.5 cm long and 15–30 mm wide, and with the styles sparsely villous with long, appressed hairs below the middle. He considered it "very closely related to *P. galapageium* and perhaps . . . only a phase of it, differing in its much broader leaves, slightly less dense eglandular indument, villous style, more definitely ciliate petals, and distinctly united sepal tips. In *P. galapageium* the tips of the sepals in mature bud are distinctly free, but in *P. socorrense* they are united to form a terminal mucronate tip for the unopened bud."

Moran tried to distinguish two species in the field but with doubtful results. The common trees with narrower leaves (*Moran 5765*), which he tentatively iden-

tified with *P. galapageium* of Johnston's treatment, were sterile in March. With them at middle elevations, but much less common, were shrubs 3 m tall (*Moran 5763*). The shrubs bore a few unseasonal buds and flowers (but none with petals) and some fruits. These specimens have the broader leaves (to 31 mm) and the basally pilose styles of *P. socorrense*, but their pubescence is glandular and their calyx in bud is open at the apex. We have seen three other flowering collections, all from middle elevations and all eglandular shrubs with narrow (less than 19 mm wide) leaves. Two of them, *Dominguez 724* and *Felger 15825*, have glabrous styles, whereas the third, *Levin 2030*, has basally pilose styles. Only *Dominguez 724* has buds, and in these the calyx is closed but the apex is not apiculate but rounded. Levin also collected fruiting specimens (2028) from a tree growing at 500 m; these have broader leaves, up to 34 mm wide, and though the styles have broken, the bases that remain are glabrous. That both broad-leaved and narrow-leaved plants grow at similar elevations and recombine the characteristics that supposedly separate the two species suggests that there is only a single species of *Psidium* on Socorro. We tentatively refer all these specimens to the next species. Miranda, too, collected both broad-leaved (8701) and narrow-leaved (8705) specimens at middle elevations and referred them to one species, concluding (pers. comm.) that there is only one species on the island. No one since Mason, however, has collected any specimens of *Psidium* on the summit plateau. The question probably cannot be settled without more good flowering and fruiting material. See the next species for a discussion of the possible relationships of the Socorro *Psidium* species.

Psidium sp. aff. *P. sartorianum* (O. Berg) Niedenzu in Engl. & Prantl, Nat. Pflanzenfam. III, Abt. 7:69. 1893.

Distribution.—At lower and middle elevations, at least 300–600 m, forming extensive thickets above *Croton* scrub in southern part of island and being in some places common in forest.

Remarks.—Johnston (1931:80) doubtfully referred specimens from near Caleta Grayson (*Mason 1676*) to *P. galapageium* Hook. f., previously considered endemic to the Galápagos Islands, and thought the more mature collections of Anthony (396) and Barkedew (s. n.) probably also conspecific. He seemed reluctant to make the identification because of the distance between the archipelagos but found the similarities compelling. This tree he described as 3–9 m tall, with leaves 3–5.5 cm long and 11–19 mm wide, growing on the forest border, scattered in groves of

Ficus and *Bumelia*. Moran found it (5765) at low and middle elevations, on exposed ridges as a shrub but in protected valleys as a tree often 10 m tall, with a straight trunk sometimes 3 dm thick. The bark is smooth, reddish brown, peeling in thin irregular plates, and cream color beneath.

Stebbins (1966) compared this tree of Socorro with typical *P. galapageium* of the Galápagos Islands (making no mention of *P. socorrense*) and was less impressed than Johnston with the similarities. In Galápagos specimens he found the leaves distinctly thinner and less coarse and the secondary veins less distinct, the fruits consistently smaller, with smaller and less conspicuous calyx lobes, and the pubescence, particularly on young leaves, recognizably different. He thought typical *P. galapageium* in many respects to be as similar to the widespread tropical American *P. sartorianum* as to the tree of Socorro; that tree, in contrast, he thought bore a considerable resemblance to *P. salutare* (Kunth) Berg, of southern Mexico. McVaugh (as quoted by Porter 1969), however, considered *P. galapageium* and the Socorro tree both closely related to *P. sartorianum*, perhaps being only insular populations of it, and *P. salutare* quite different and not closely related. McVaugh (1963) had previously stated that the specific limits of *P. sartorianum* were somewhat in doubt. As everyone who has examined this species complex has pointed out, this group is badly in need of revision. More flowering and fruiting collections from Socorro are needed.

Nyctaginaceae

Key to Species

1. Plants perennial; fruits glandular-pubescent.....*Boerhavia coccinea*
1. Plants annual; fruits glabrous.....*Boerhavia erecta*

Boerhavia coccinea Miller, Gard. Dict. ed. 8, no. 5. 1768.

Boerhavia caribaea Jacq., Observ. Bot. 4:5. 1771.

Distribution.—Fairly common near shore in southern part of island (Caleta Binner, Caleta Castelán, Bahía Braithwaite). Also found north of Laguna Escondida in 1981 (Moran 29533) and along road to head of Cerro Evermann trail in 1988 (León 3436; Levin 2041); it may be introduced in both these places. Southern United States and West Indies through Mexico to southern South America; Galápagos Islands.

Remarks.—Species delimitation is controversial within the complex of *Boerhavia* having glandular-pubescent fruits. Standley (1918) and Eliasson (1971:223–224) recognized *B. diffusa* L. in the Old World and *B. caribaea* and *B. coccinea* in the New. In

their treatments the Socorro plant, with its glandular-ciliolate leaves and glandular-pubescent inflorescence, falls under *B. caribaea*. Standley and Steyermark (1946), followed by such authors as Woodson and Kidd (1961) and Bogle (1974), thought the New World plants indistinguishable from *B. diffusa*. In contrast, F. R. Fosberg (pers. comm.), after studying the types of *B. diffusa* and *B. coccinea*, considered *B. diffusa* an endemic of southern India and Ceylon. As in his earlier study (Fosberg 1978), he remained uncertain whether the two American species could be separated. We tentatively follow such authors as Reed (1969:204, 1970:595), Munz (1974:582), and Correll and Correll (1982:486), who recognized only one species for the New World.

****Boerhavia erecta*** L., Sp. Pl. 3. 1753.

Distribution.—Common along disturbed roadsides northeast of Bahía Braithwaite (Levin 1777). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Widespread weed in American tropics, ranging from the West Indies and southern United States through Mexico to South America; introduced in Old World tropics.

Oleaceae

Forestiera rhamnifolia Griseb., Cat. Pl. Cub. 169. 1866.

Distribution.—Occasional in forest from 400 m to summit plateau at 950 m. West Indies, Tamaulipas, Belize.

Remarks.—This is a semiscandent shrub to 4 m tall or 6 m long, the trunk to 1.5 dm thick. A few dried fruits remain on Moran 5764, collected in March 1957. These are ellipsoidal, dark red to black, mostly 8–11 mm long and 4–6 mm thick.

Johnston, who had seen only blighted staminate flowers and no fruit, stated (1931:83) that so far as comparisons could be made, the Socorro plant seemed inseparable from *F. rhamnifolia* and that it must represent either that species or a closely related endemic one. Good flowering material is yet to be collected. Compared with the little West Indian material we have seen, the Socorro plant has somewhat larger and thicker leaves and larger fruits.

Papaveraceae

****Argemone ochroleuca*** Sweet, Brit. Fl. Gard. 3:t. 242. 1829, subsp. *ochroleuca*

Distribution.—Common on bare area near km 5 on airport road, west of Cabo Pearce (Moran 25518); common along airport road at 200 m (Dominguez 709); occasional in arroyo, Caleta Castelán near main

landing (*Moran 29498*); common in disturbed areas north of Bahía Braithwaite (*Levin 1758*). Seen at roadsides to 400 m. Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Common weed in northern and central Mexico.

Passifloraceae

Passiflora sp.

Distribution.—Local among rocks on east ridge of Cerro Evermann at 980 m (*Moran 5840*); rare in low forest in ravine north-northwest of Cerro Evermann at 1000 m (*Levin 2046*). Not previously reported for Socorro.

Remarks.—Both collections are sterile. They are very nearly glabrous, except on the new growth, and lack glandular trichomes. They resemble some glabrous forms of the widespread and variable *P. foetida* L., but better material obviously is needed for an identification.

Piperaceae

Key to Species

- 1. Leaves alternate, oblong to elliptic, 2–6 cm long *Peperomia socorrionis*
- 1. Leaves in whorls of 4, orbicular, 1–1.4 cm long *Peperomia tetraphylla*

Peperomia socorrionis Trel. in I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:58. 1931.

Distribution.—On tree trunks in upper part of island around 500–900 m, more common toward upper end of range but generally not as common as the next species. Endemic to Isla Socorro; type from near the summit of Cerro Evermann, *Mason 1653* (CAS 186616).

Remarks.—Trelease was extremely vague as to the relationships of this and the next species and their distinctions, if any, from mainland species, saying only that they seemed distinct and more closely related to Mexican and Guatemalan species than to South American. T. G. Yuncker, after examining *Moran 5857*, said (pers. comm.) that he knew of no other species to which *P. socorrionis* might be referred and he believed it might be a valid species. He pointed out, however, that group *Sphaerocarpidium*, in which he placed this species, is a difficult part of the genus and that he had made no special study of the Mexican species.

Peperomia tetraphylla (G. Forster) Hook. & Arn., Bot. Beechey Voy. 96. 1832.

Peperomia reflexa (L. f.) A. Dietr., Sp. Pl. ed 6, 1:180. 1831; non *P. reflexa* Kunth, 1815.

Peperomia chrysolepida Trel. in I. M. Johnston, Proc.

Calif. Acad. Sci., ser. 4, 20:57. 1931. Type from Isla Socorro without exact locality, *Barkewlew 228* (US 3999023).

Distribution.—Common epiphyte in forest around 500–950 m. Panropical.

Remarks.—T. G. Yuncker examined *Moran 5795* and wrote (pers. comm.) that he could see no difference between *P. chrysolepida* and *P. tetraphylla* except that the specimen was not quite as pubescent as many specimens of that variable species.

Portulacaceae

Key to Species

- 1. Petals yellow; leaf blades flattened; leaf axils essentially devoid of hairs *Portulaca oleracea*
- 1. Petals purple; leaf blades terete or slightly flattened; leaf axils densely white-pilose *Portulaca pilosa*

**Portulaca oleracea* L., Sp. Pl. 445. 1753.

Distribution.—Occasional in disturbed places at south end, as near houses at Caleta Castelán (*Moran 25448*) and along roadsides northeast of Caleta Castelán to 400 m (*Levin 1782*; *Moran 25522*). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Cosmopolitan weed.

Portulaca pilosa L., Sp. Pl. 445. 1753.

Distribution.—Reported for Socorro on the basis of a collection by Townsend (s. n.) and not collected since. Southeastern United States through Mexico and the West Indies to South America.

Townsend landed at Bahía Braithwaite and, we judge from his plant list (Vasey and Rose 1890), collected only near the shore. The plant commonly grows on upper beaches and other sandy places.

Rhamnaceae

Rhamnus sharpii M. & L. A. Johnston, Flora Neotrop. Monogr. 20:74. 1978.

Rhamnus discolor (J. D. Smith) Rose, Contr. U. S. Natl. Herb. 8:51. 1903; non *Rhamnus discolor* Lesq., 1878. *Rhamnus capreaefolia* Schldl. subsp. *discolor* (J. D. Smith) C. Wolf, Rancho Santa Ana Bot. Gard. Monogr., Bot. Ser. 1:116. 1938.

Distribution.—Apparently uncommon on rocky forested slopes above at least 700 m. Southern Mexico and Guatemala.

Remarks.—Johnston (1931:75) expressed some doubts when he referred *Mason 1667*, the only collection from Socorro he had seen, to this species. Johnston and Johnston (1978), however, identified both that collection and *Felger 15827* as *R. sharpii*.

Rosaceae

Key to Species

1. Plants trees; carpel 1; fruit a drupe *Prunus serotina*
1. Plants scandent shrubs; carpels many; fruit an aggregate of drupelets *Rubus* sp.

Prunus serotina* Ehrh., Beitr. Naturk. 3:20. 1788, subsp. *serotina

Distribution.—Occasional in forest at 500–700 m. Southeastern Canada through eastern United States to Mexico and Guatemala.

Remarks.—Johnston (1931:22) called the Socorro plants *P. capuli* Cav. McVaugh (1951) cited the collections of Howell (8413), Mason (1635), and Solís (45, 87), assigning them to *P. s. serotina* and commenting that they appeared to represent a distinct native population but were typical of that subspecies.

***Rubus* sp.**

Distribution.—Rare in canyons on eastern slope of island at 600–800 m.

Remarks.—Both collections of this species (*Miranda* 8756; *Mason* 1654) are sterile. Johnston (1931:61) thought Mason's specimen looked much like *R. schiedianus* Steud., a species of southern Mexico and Guatemala.

Rubiaceae

Key to Species

1. Plants herbaceous or woody only at base
 2. Leaves whorled; inflorescence an open cymose panicle; calyx obsolete; fruit a schizocarp ... *Galium mexicanum*
 2. Leaves opposite; flowers in dense axillary glomerules; calyx well-developed, the sepals in 2 pairs of unequal length; fruit a circumscissile capsule ... *Mitracarpus hirtus*
1. Plants shrubs or trees, woody well above the base
 3. Flowers in dense axillary glomerules; fruit a capsule *Spermocoe nesiotica*
 3. Flowers in open cymes or racemes; fruit a drupe
 4. Leaves suborbicular to oval or ovate; leaf venation prominent, definitely raised on the underside; stipules deciduous; inflorescence a cyme *Guettarda insularis*
 4. Leaves lanceolate to oblong-ovate; leaf venation obscure, not raised; stipules persistent; inflorescence a raceme *Chiococca alba*

***Chiococca alba* (L.) A. Hitchc., Annual Rep. Missouri Bot. Gard. 4:94. 1893.**

Distribution.—Occasional in forest and in brush from near shore to ca. 600 m. Widely distributed in the American tropics, ranging north along the Pacific Coast to Sonora and the Cape region of Baja California.

Remarks.—Johnston (1931:96) stated from Mason's notes that this plant frequents shady cañons and dense forests, where it often ascends trees even to a height of 20 m and from them hangs in festoons clear to the

ground. One of Moran's collections (5777) was from such a situation, where the plant climbed to a length of about 7 m and had pendent branches. Most other collections, however, were from brushy places, where the plant was a slender shrub about 1 m tall. Howell (8439, CAS) noted that at Bahia Academy it was a shrub 2 to 3 feet high on dry slopes, whereas it was a vine in cañon bottoms, as also in the higher forest.

Because the material available to Johnston lacked normal flowers, he had some doubt as to the identification. More recent collections with both flowers and fruit (e.g., *Moran* 5777) seem not to differ from mainland material, however.

Galium mexicanum* Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 3:337. 1818, subsp. *mexicanum

Distribution.—Occasional on upper slopes, from 600 m to summit. Though we found it only above 900 m, L. M. V. de Puga (pers. comm.) reported it at 600–1000 m, and Stockton, who found no plants that we think are restricted to the summit, also collected it (as *Anthony* 386). Southern Arizona through Mexico to Panama.

Remarks.—Brandeggee labeled *Anthony* 386 as a new species but never published it. Dempster (1978:22) considered all the Socorro material to be *G. mexicanum mexicanum*.

***Guettarda insularis* T. S. Brandeggee, Univ. Calif. Publ. Bot. 10:416. 1924.**

Distribution.—Widespread on the island; common in forest, occasional in *Croton* scrub and near summit. Endemic to Isla Socorro; type without exact locality, *Anthony* 377 (UC).

Remarks.—In the forest this may be a tree 6 m tall, with a fluted trunk 2 dm thick; in more open spots it is a shrub 0.5–4 m tall. The bark is smooth; the new surfaces are light tan, becoming brown and finally dark red. Since the bark peels in thin irregular plates, the trunk appears mottled.

Standley (1926:1384) included *G. insularis* in *G. elliptica* Sw., of southern Florida, the West Indies, southern Mexico (on the Pacific coast north to Sinaloa), and northern Central America. Johnston (1931:33, 97) considered it a Socorro endemic, weakly distinguished from *G. elliptica* by having apparently larger corollas and much larger and more elongate fruit. We have seen few specimens from plants in flower or fruit. Two collections (*Moran* 5866, 29527) have dried corollas 8–9 mm long and thus well within the range for mainland material (6–9 mm *fide* Standley and Williams 1975), and a third (*Moran* 25492) has much longer corollas, 11–13 mm when dry. Three collections (*León* 3480; *Moran* 5768, 29525) have old dried fruits

10–14 mm long and 6–9 mm wide, about as large as those measured by Johnston, but the fruits of *Howell 8447* are smaller; drupes of the mainland form are globose and 4–8 mm in diameter. Because there may be a tendency toward larger corollas and particularly toward more elongate fruits in the Socorro plant, we tentatively recognize it as a distinct species.

****Mitracarpus hirtus* (L.) DC., Prodr. 4:572. 1830.**

Distribution.—Common to abundant in disturbed places at middle elevations on the south side of island, as at Cerro Evermann trailhead, 500 m (*Levin 2026*), and along the road to the trailhead at 350 m (*Levin 2037*); uncommon near summit (*Levin 2043*), along airport road at 250 m (*León 3458*), and in disturbed area north of Bahía Braithwaite (*Levin 1766*). Not previously reported for Socorro and evidently a recent arrival. Weed from the southwestern United States through Mexico to South America.

Remarks.—Since its arrival apparently sometime between 1981 and 1987, this weed has spread aggressively, probably carried by sheep. By 1988 it had become one of the most abundant herbs in the overgrazed area north of Huerta Grande, though Moran did not see it when he walked through there in 1981. It is one of two introduced plants known to have reached the summit of the island.

***Spermacoce nesiotica* (Robinson) Levin, comb. nov.**

Borreria nesiotica Robinson, Proc. Amer. Acad. Arts 45:409. 1910.

Distribution.—Widespread in northern half of island from shore to summit, generally abundant in scrub vegetation. Endemic to islas Clarión and Socorro; type from Clarión or Socorro, without exact locality, *Anthony s. n.* (GH).

Remarks.—This is a subwoody bushy perennial sometimes 1 m high, with white flowers.

Because recent students of the Rubiaceae such as Verdcourt (1975, 1983) and Fosberg (1987) have considered the slight difference in fruit dehiscence insufficient for separating *Borreria*, we place this species in *Spermacoce*.

Johnston (1931:97) thought *S. nesiotica* a very well defined species, perhaps most closely related to *S. verticillata* L., with which Robinson had compared it, or to *S. assurgens* Ruiz Lopez & Pavón (for which Johnston used the widely misapplied name "*B. laevis*"; see Verdcourt 1983 and Fosberg 1987). Both these species are widespread and weedy, ranging from southern Mexico and the West Indies through South America. With *S. assurgens*, *S. nesiotica* shares transversely striate seeds and most other characteristics; it differs mainly in its perennial habit and internally

glabrous corolla lobes. The perennial *S. verticillata* differs from *S. nesiotica* in its pitted seeds and bisepalate calyx and also in several minor characteristics. F. R. Fosberg (pers. comm.) considered *S. nesiotica* closest to *S. verticillata*, noting that sepal number varies within many species of *Spermacoce*.

Rutaceae

***Zanthoxylum insulare* Rose, N. Amer. Fauna 14:79. 1899.**

Distribution.—Occasional in forest at middle elevations, at least 550–850 m. Jamaica, Islas Tres Mariás, northwestern South America; type from Isla María Madre.

Remarks.—This is an erect to scandent shrub, with the stem to 1 dm thick at the base and to 5 m long.

Sabiaceae

***Meliosma nesites* I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:73. 1931.**

Distribution.—Occasional in forest on east slope of island at 600–800 m. Endemic to Isla Socorro; type from east slope, *Mason 1622* (CAS 186617).

Remarks.—Johnston (1931:74) thought this species most closely related to *M. idiopoda* S. F. Blake, now known to range from extreme southern Mexico to Panama (A. H. Gentry 1980) and to have affinities to *M. glabrata* (Liebm.) Urban of Panama and Costa Rica. He had only the type collection of the Socorro plant, however, which has only fruits and old flowers without petals. Additional collections (*Felger 15809, 15837; Moran 25508*) show the outer petals to be 2.5–3.1 mm long and 3.5–4.0 mm wide. *M. idiopoda* has outer petals only 1 mm long. Furthermore, as reported by Johnston and confirmed by the specimens cited above, dry fruits of *M. nesites* are subglobose and up to 12 mm in diameter, whereas dry fruits of *M. idiopoda* are 6–8 mm in diameter. *M. glabrata* has petals about as long as those of *M. nesites*, but they are only 2 mm wide, and *M. glabrata* also differs in having ramiflorous rather than axillary inflorescences and pyriform-globose fruits 1.5–2.5 cm long and 1.5–2 cm in diameter.

According to A. H. Gentry (1980), who apparently was unaware of *M. nesites*, *M. dentata* (Liebm.) Urban is the only neotropical *Meliosma* with small fruits and petals over 1 mm long. In its inflorescence placement, petal size and shape, and fruit shape, *M. nesites* agrees quite well with *M. dentata*, which ranges from southern Chihuahua to Guatemala. The Socorro plant differs in having shorter pedicels (about 1 mm long vs. 2–4 mm), longer styles (1.5 mm vs. 1 mm), and somewhat larger fruits (up to 1.2 cm in diameter when

dry vs. up to 1.0 cm). Thus it would appear that *M. nesites* is a distinct species most closely related to *M. dentata*.

Though it has little bearing on the relationships of the species, it is worth noting that whereas Johnston (1931:74) described the leaves of *M. nesites* as "quite entire," all the specimens we have seen (*Felger 15809, 15837, 15861; Miranda 8755; Moran 25508*) have sharp, upward-curving teeth on the margins of at least some of their leaves.

Sapindaceae

Key to Species

1. Leaves compound; inflorescences bearing tendrils below the flowers.....*Cardiospermum halicacabum*
1. Leaves simple; inflorescences without tendrils*Dodonaea viscosa*

***Cardiospermum halicacabum* L., Sp. Pl. 366. 1753.**

***Cardiospermum corindum* L., Sp. Pl. ed. 2. 526. 1762.**

Distribution.—Uncommon, in open and brushy places at low and middle elevations, up to at least 700 m. Widely distributed in the tropics of both hemispheres.

Remarks.—Johnston (1931:72) recorded a glabrous form from Clarión and a pubescent form from Socorro. Most Socorro specimens are pubescent throughout, but those of *Moran 5869* vary from pubescent throughout to glabrous except for some young growth. Howell also collected both pubescent and glabrous forms.

Most recent authors do not distinguish *C. corindum* from *C. halicacabum*. If further work shows them to be distinct, the Socorro plant would probably be assigned to *C. corindum*. Both are pantropical.

***Dodonaea viscosa* Jacq., Enum. Syst. Pl. 19. 1760.**

Distribution.—Abundant at middle elevations on talus and rough lava; locally common elsewhere down to sea level and occasional at summit. Southern Arizona through Mexico and the West Indies to South America; Old World tropics.

Remarks.—Sherff (1947) cited the collections of Anthony, Barkelew, and Mason as *D. viscosa* var. *linearis* (Harvey & Sonder) Sherff forma *angustifolia* (Benth.) Sherff, which has essentially the distribution of the species.

Sapotaceae

***Bumelia socorrensis* T. S. Brandegee, Zoe 5:106. 1901.**

Distribution.—Common in forest and occasional in brushy areas in upper half of island, above 400 m. Endemic to Isla Socorro; type without exact locality, *Anthony s. n.* (UC 168038).

Remarks.—Near the top of the peak this plant grows as a low shrub, but in the forest it is a tree often 10 m tall, with a branch spread sometimes of 30 m. The trunk may be as much as 2 m thick, or often there are several trunks arching from a common base. The bark is dark brown to black. In early March, few flowers were left, but the trees were heavily laden with green fruit.

Cronquist (1945) believed this species, though sharply distinct, most closely allied to *B. persimilis* Hemsley, of mainland Mexico and Venezuela, and to *B. peninsularis* T. S. Brandegee, of the mountains of the Cape region, Baja California.

Scrophulariaceae

Key to Species

1. Leaves deeply pinnatifid, hispid, all alternate; corolla with a galeate upper lip and rudimentary lower lip, not spurred*Castilleja socorrensis*
1. Leaves entire, glabrous, at least the lower ones opposite; corolla with a spreading upper lip and well-developed lower lip, spurred at base*Linaria canadensis*

***Castilleja socorrensis* Moran, sp. nov. (Figures 16 and 17)**

Type.—Isla Socorro, Mexico: fairly common in low vegetation, east slope near summit of Cerro Evermann at 980 m, near 18°46.5'N, 110°57.5'W, 4 April 1981, *Moran 29505* (Holotype: SD 108316; isotypes: ARIZ, BISH, CAS, ENCB, F, MEXU, MICH, MO, NY, RSA, TEX, UC, US).

Planta annua 1.5–3.5 dm alta hispida glanduloseque pubescens. Folia ovata 2–5 cm longa pinnatisecta, segmentis 4–10 linearibus subremotis. Calyx 10–17 mm longus, antice posticeque subaequaliter 3.5–5.5 mm fissus, segmentis 1.5–3 mm fissis. Corolla 8–10 mm longa, galea 1.5–2.5 mm longa. Filamenta ca. 3 mm longa. Stylus ca. 4 mm longus. Typus: *Moran 29505* (SD 108316). Species *C. bryantio* affinis sed corolla brevior et galea styloque pro portione minore differt.

Plant annual, purplish in age, hispid and glandular-pubescent, the trichomes spreading, simple, of 2–5 cells, whitish, tapering, 0.2–1.3 mm long, the smaller ones gland-tipped. Stems erect, 1.5–3.5 dm tall, 1–4 mm thick at base, unbranched or with several usually closely ascending branches. Leaves ovate in outline, 2–5 cm long, pinnately divided, the lateral segments 4–10, divergent, linear, rounded at apex, 0.5–1.5 mm wide, to 22 mm long. Inflorescence a lax spike 6–13 cm long, with 7–18 flowers, the bracts and calyx normally red-tipped, but occasionally yellowish. Bracts like leaves but smaller and with fewer segments, the upper 1–2 cm long, commonly with two ascending linear segments from near base, often also with small pair above middle. Calyx 10–17 mm long, 5–7 mm in greatest circumference about one-third above base, about equally cleft before and behind for 3.5–5.5 mm, the segments



Fig. 16. Holotype of *Castilleja socorrensis*.

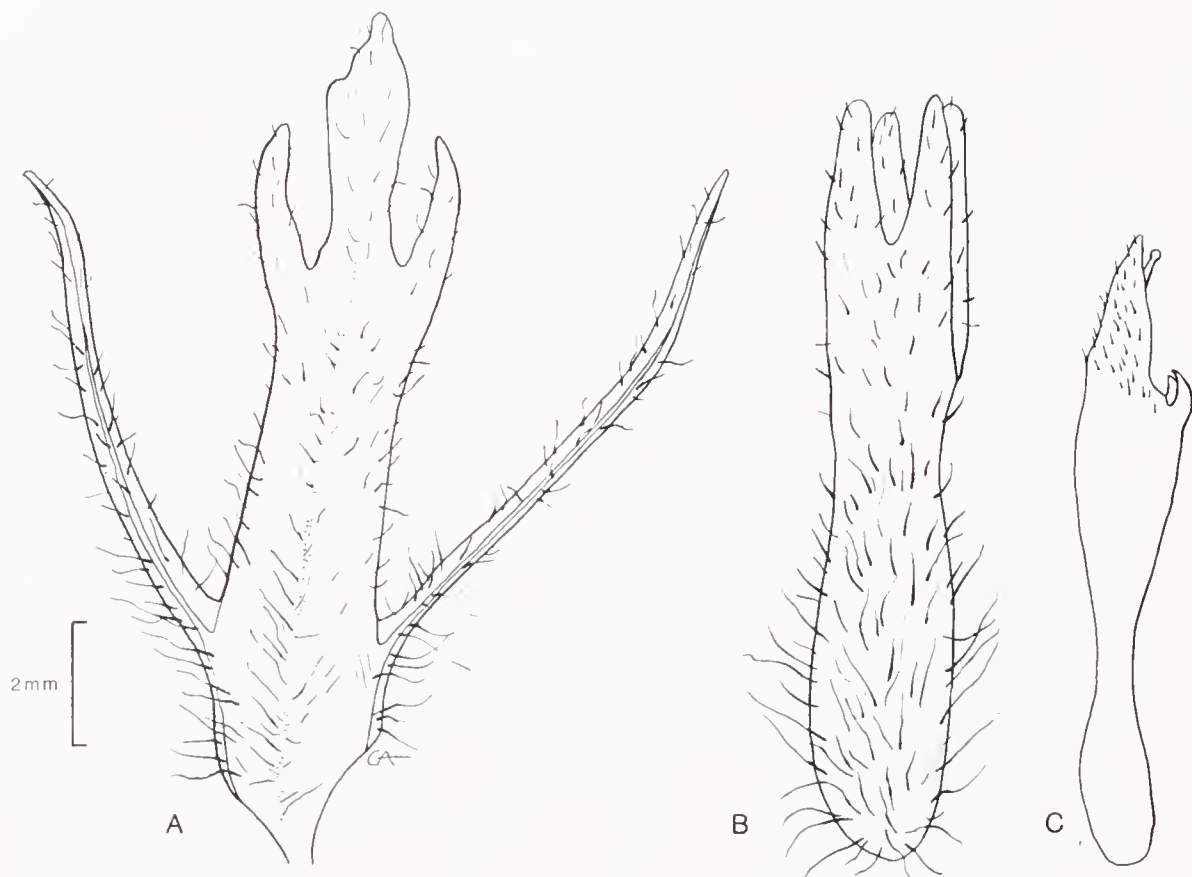


Fig. 17. *Castilleja socorrensis*. A, bract; B, lateral view of calyx; C, lateral view of corolla (all Moran 29505, the holotype).

cleft 1.5–3 mm into oblong acutish somewhat divergent lobes, the posterior ca. 1–1.2 mm wide, the anterior slightly narrower and shorter. Corolla 8–10 mm long, the tube 6.5–8 mm long, ca. 3.25 mm in circumference throughout, with 17 veins from base, splitting posteriorly with enlargement of ovary; lower lip 7–8.5 mm from corolla base, the lobes yellowish, subquadrate, ca. 0.5 mm long and wide; palate with two erect fin-like evaginations ca. 0.7 mm long and 0.3 mm high, each ca. 0.3 mm below sinus; galea 1.5–2.5 mm long. Stamens glabrous; filaments ca. 3 mm long, the anterior inserted 5.5 and the posterior 5 mm above corolla base; anthers ca. 1 mm long and a third to half as wide. Ovary ca. 5.5 mm long; style filiform, 4 mm long; stigma lobes ca. 0.3 mm long. Capsule pale brown, ellipsoid, bowed posteriorly, 8–9 mm long, 2–3 mm thick, splitting nearly to base, the two valves obliquely lanceolate, acuminate, often shortly bifid. Seeds numerous, prismatic-ovoid, 0.7–0.8 mm long, 0.4–0.5 mm thick; testa white, alveolate, the alveolae separated by delicate walls, the larger alveolae ca. 0.2 mm wide and 0.1 mm deep; solid body of seed fusiform, yellow-brown, ca. 0.6 mm long and 0.25 mm thick.

Paratypes.—Ridge northwest of Cerro Evermann at

915 m, *Levin 1808* (SD), *Levin 1811* (SD, MEXU); near summit of Cerro Evermann, *Felger 15773* (ARIZ, SD), *Miranda 8740* (MEXU), *Moran 5830* (BM, CIB, ENCB, NY, SD, UC, US); without specific locality, *Patiño s.n.* (MEXU).

Distribution.—Endemic to Isla Socorro. Locally common in summit grassland above about 915 m.

Relationships.—This plant is most closely related to *C. bryantii* T. S. Brandegee, of southern Baja California from near sea level to about 1800 m. It is, in fact, very similar in habit, foliage, pubescence, fruits, and seeds, though the specimens are not so large as the larger ones of *C. bryantii*. It is also similar in general floral structure, but the flowers are smaller and their proportions are different. In particular, the galea and style are proportionally much smaller. Some measurements of *C. bryantii* for comparison: plant 1.5–6 dm tall; calyx 15–31 mm long; corolla 14–21 mm long, the tube 10–15 mm long, the galea 4–7 mm long; filaments 4–6 mm long; style 8–16 mm long.

***Linaria canadensis* (L.) Dum.-Cours. var. *texana* (Scheele) Pennell, Proc. Acad. Nat. Sci. Philadelphia 73:502. 1921.**

Distribution.—Occasional in rocky places near summit (Moran 5827, 5837, 29515). Not previously reported for Socorro. Canada to Mexico and South America.

Remarks.—The specimens are small, mostly 3 to 15 cm tall, often with several branches from the base and thus rather bushy. In one collection (5837) some are broken off above, presumably by sheep, and might have been a little more than 15 cm tall. The corollas are small, about 1.25 mm long, 1 mm wide at the base, and 0.5 mm wide above; the lobes are subequal. Some corollas are clearly personate and open, bluish at the apex, slightly gibbous at the base anteriorly and less so posteriorly. In some old corollas, adhering to the fruit, the lobes are still neatly imbricated; these flowers are thus evidently cleistogamous. The anthers often adhere to the stigma, and the old corolla, forced off by the expanding capsule, may thus remain attached.

Brandege (1900a) pointed out that *Linaria canadensis* [texana] of the San Diego, California, area may have many cleistogamous flowers on the lower part of the main branches and the whole length of many side branches. Munz (1926:330) cited two specimens from southern California with reduced and cleistogamous flowers. Two collections from San Diego County (Gander 1114 and 3477, SD) have only very small and apparently cleistogamous flowers. As in the plants of Isla Socorro, these are much smaller than the normal chasmogamous form, and the old corollas often adhere to the capsules. The San Diego plants differ from the plants of Socorro in being mostly simple and weak, with the leaves more scattered. There is no information as to the genetic relationship of the cleistogamous and chasmogamous forms. On Socorro, so far as Moran saw, the entire population is of the small-flowered form.

Solanaceae

Key to Species

1. Corolla tubular, over 1 cm long
 2. Plants shrubs to small trees; pubescence stellate; corolla about 1–1.5 cm long; fruit a berry ... *Cestrum pacificum*
 2. Plants herbaceous; pubescence simple; corolla about 5 cm long; fruit a capsule *Nicotiana stocktonii*
1. Corolla rotate or funnelform, less than 5 mm long
 2. Calyx enlarged and inflated in fruit, investing the berry
 3. Plants glabrous, 7–20 cm tall; calyx in fruit 8–14 mm long *Physalis mimulus*
 3. Plants viscid-pubescent, 0.8–2 m tall; calyx in fruit 30–45 mm long *Physalis nicandroides*
 2. Calyx not enlarged and inflated in fruit
 4. Plants herbs, unarmed; pubescence scanty, white, simple; corollas 5–7.5 mm wide *Solanum americanum*
 4. Plants shrubs, armed with prickles; pubescence dense, yellowish, stellate; corolla 1.5–2 cm wide *Solanum madrense*

Cestrum pacificum T. S. Brandege, Erythea 7:6. 1899.

Distribution.—Apparently rare, on talus and in dense scrub at about 700–950 m. Although this is a conspicuous grayish shrub 1–2.5 m tall, Moran saw only two individuals in 1957 and one in 1978. Endemic to Isla Socorro; type without exact locality, *Anthony* 391 (UC 34891).

Remarks.—Standley (1924:1281), Johnston (1931:95), and Francey (1935:166) all recognized *C. pacificum* as a Socorro endemic, though Johnston thought it a weak species. Francey called it the most tomentose of the entire genus. Apparently the young parts are always densely tomentose, though the leaves may be glabrescent above. However, *C. lanatum* M. Martens & Galeotti, a wide-ranging species of southern Mexico and Central America, is much more variable in pubescence, and some specimens are scarcely less tomentose than *C. pacificum*. Johnston thought *C. pacificum* might be no more than an insular phase of *C. lanatum*, with shorter corollas; however, though the corollas are generally shorter in *C. pacificum*, there is some overlap in length. A more consistent difference, used in Francey's key, is in the length of the calyx—about 7–8 mm in *C. pacificum* and 4–5.5 mm in *C. lanatum*. The longer calyx and generally shorter corolla of *C. pacificum* combine to give it a consistently distinctive appearance. Thus in *C. pacificum* the calyx is about half as long as the corolla, whereas in *C. lanatum* it is about a fourth to a third as long. Although the two plants undoubtedly are close, they appear to be distinct.

Nicotiana stocktonii T. S. Brandege, Erythea 7:6. 1899.

Nicotiana nesophila I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:93. 1931.

Distribution.—Common on sea bluffs and occasional elsewhere along shore; fairly common and increasing in overgrazed area north of Huerta Grande. Endemic to islas Socorro and Clarión; type of *N. stocktonii* from Socorro without exact locality, *Anthony* 382 (UC 103900, 103901), of *N. nesophila* from alluvial sands at the mouth of a valley near Caleta Binner, *Mason* 1596 (CAS 186608). Although the type of *N. stocktonii* is under Anthony's number, presumably A. L. Stockton was the real collector (see discussion under Botanical Collectors).

Moran found *N. stocktonii* in 1978 locally common in nearly bare soil at 300 m by the airport road (25525) and in 1981 in several patches about scattered trees of *Ficus*, *Bumelia*, and *Psidium* north of Huerta Grande at 400 m, where it was the only herb (29530). By 1988 it was common in bare areas around trees along the road from there toward the head of the Cerro Evermann trail, up to about 500 m (León 3497, Levin 2049). We do not of course know whether it is native there

or was somehow brought in along the new road and jeep track, though the plant does appear to be spreading. Very likely it is distasteful to the sheep that keep that part of the island nearly bare of herbs. Possibly the lack of competing herbs lets it grow inland only there. In bare soil north of Huerta Grande Moran also found one old plant of *Perityle socorrensis*, likewise mainly a plant of seacliffs.

Remarks.—Johnston (1931:93) wrote that *N. nesophila* differed decisively from *N. stocktonii* “in its much less viscid indument of paler shorter hairs, in its inconspicuously rather than very conspicuously winged petioles, and in its narrower more elongate leaf-blades which are obtuse or broadly acute rather than strongly cordate or reniform at the base. The new species has also more strongly crenate leaf-margins.” The type specimen of *N. stocktonii* is clearly labeled as from Socorro. However, because he doubted that two such closely related species could remain distinct on the same island, and because all other collections that he referred to typical *N. stocktonii* were from Clarión, Johnston thought that the type collection probably was mislabeled and had in fact also come from Clarión rather than from Socorro. Thus he supposed that *N. stocktonii* was endemic to Clarión and *N. nesophila* was endemic to Socorro. Goodspeed (1954) accepted Johnston’s conclusions and offered no further comments on the relationship or distinctions of the two species.

There seems little reason to question any of Anthony’s labels except possibly those of *Scaevola plumieri* and the type collection of *Nicotiana stocktonii*. The number of this collection (382) falls in the series (375 to 401) for Socorro, and the type sheets are dated as of May 4, the second day the party was on the island; see discussion under Botanical Collectors. Thus number and date are consistent with the stated origin on Socorro, and there seems no reason to question the labels unless because of the morphology of the specimens. After comparing these specimens with collections from six localities on Socorro, we see no reason to doubt that Anthony’s labels are correct. Since the ship sailed May 3 from San Benedicto to the southwest side of Socorro, it seems likely that the type of *N. stocktonii* is from that part of the island.

On Socorro the *Nicotiana* varies in all the characters used by Johnston to differentiate two species. The variation is to some extent within populations and to some extent between populations. Later collections from Caleta Binner are similar to the type of *N. nesophila*, whereas some specimens from Bahía Academy and Caleta Grayson are more like the type collection of *N. stocktonii*. The specimens from dif-

ferent parts of the island do not seem to fall into two distinct groups, however, and it does not seem feasible to recognize two taxa. Furthermore, plants assigned to the two taxa have identical karyotypes unique within the genus (Goodspeed 1945a,b; Clausen 1949) and produce fully fertile hybrids (Goodspeed 1945b).

N. stocktonii evidently is most closely related to *N. repanda* Willd., of southwestern Texas and northeastern Mexico. They are similar morphologically, have similar karyotypes, and are highly crossable (Goodspeed 1945a,b, 1954; Clausen 1949).

Physalis mimulus Waterf., *Rhodora* 69:211. 1967.

Physalis sp. 1. M. Johnston, *Proc. Calif. Acad. Sci.*, ser. 4, 20:92. 1931.

Distribution.—On upper beach, fairly common at south end of island (Caleta Binner); rare at north end (Bahía Academy). Endemic to Isla Socorro; type without exact locality but presumably from near Bahía Braithwaite, *Townsend s. n.* (US).

Remarks.—On the basis of Moran’s collections (5721, 5881) and preserved material from S. Carlquist, the brief original description may be expanded as follows. Glabrous annual, 7–20 cm tall, 10–30 cm wide. Tap root 2–6 mm thick at top. Branches several from base, erect or ascending, straight or often conspicuously zigzag, subterete or angled, the internodes 5–35 mm long, those of one branch averaging ca. 9–15 mm long. Leaves petiolate; blades thickish, ovate, commonly somewhat oblique, acute or mostly sub-obtuse to rounded, mostly cordate at base, 6–25 mm long, 4–20 mm wide, the margins irregularly crenate or repand and somewhat crisped, the veins ca. 3–5 on each side, mostly ascending at ca. 45° and curving upward near margin, or the lower spreading or descending; petioles 2–30 mm long, slender. Flowers axillary, the pedicels slender, abruptly thickening at base of calyx, at anthesis 2–6 mm long, in fruit often recurved, 6–11 mm long. Calyx at anthesis cup-shaped, weakly 5-angled, 2–2.75 mm long, 1.5–2.25 mm wide, truncate to weakly umbilicate at base, the segments deltoid, acute, 0.7–0.9 mm long, 1.1–1.3 mm wide; in fruit ovoid to subglobose, scarcely angled, 8–14 mm long, 8–12 mm thick, rounded or slightly umbilicate at base, the teeth erect or somewhat connivent, deltoid, acute, 1.0–2.2 mm long, 1.4–1.7 mm wide. Corolla yellowish white with purplish brown center, funnelform, ca. 5 mm long, the tube 2.5–3 mm long, enlarging slightly upward, with a low glandular protuberance ca. 1 mm long at each side of base of each filament and parallel with its axis; the limb bowl-shaped, 5–7 mm wide, broadly and very shallowly lobed. Stamens unequal, the filaments subclavate, 3–4 mm long, ca. 0.3 mm

thick at base and 0.4 mm thick above, inserted ca. 1 mm above base of corolla; anthers bluish, 0.9–1.1 mm long. Ovary 1.2–1.8 mm long, 0.6–1.1 mm thick; style 2.5–3 mm long, ca. 0.2–0.3 mm thick; stigma capitate, 0.4–0.5 mm wide. Fruit subglobose, ca. 6–8 mm thick, with 25–65 seeds. Seeds yellowish brown, ovate-lenticular with rounded edges, 1.4–1.8 mm long, 1.2–1.5 mm wide, ± 0.5 mm thick, the surface with irregular pits 0.03–0.15 mm long and ca. 0.05 mm deep, separated by flattened wavy ridges \pm uniformly ca. 0.02 mm wide.

Waterfall (1967) did not compare this species with any other. It would appear from his key and sequence of species, however, that *P. mimulus* is most closely related to *P. crassifolia* Benth., of the southwestern United States and western Mexico, or more probably to *P. angulata* L., widespread in the warmer regions of both hemispheres. Waterfall (1967) also described the Clarión endemic *P. clarionensis*, which he compared with *P. angulata* and *P. philadelphica* Lam.

***Physalis cf. nicandroides** Schldl. var. *attenuata* Waterf., *Rhodora* 69:235. 1967.

Distribution.—Rare in disturbed area south of the airstrip (*Dominguez* 725). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1988. Widespread in Mexico from the northern tier of states south to Central America.

Remarks.—When collected in September 1988, this plant had only flowers and very young fruits. Without mature fruits, certain identification is impossible.

***Solanum americanum** Mill., *Gard. Dict.* ed. 8, no. 5. 1768.

Solanum nodiflorum Jacq., *Collectanea* 2:288. 1789.

Distribution.—Wild area just north of Huerta Grande, north of Laguna Escondida (*Moran* 29534). Grown for fruit at Huerta Grande. Not previously reported for Socorro and obviously a recent escape from cultivation; first collected there in 1981. The plant is weedy and pantropical.

Solanum madreense Fern., *Proc. Amer. Acad. Arts* 35:558. 1900.

Distribution.—Rather uncommon on south half of island, from near shore at least to 700 m. Western Mexico, from Sonora south, and Central America.

Sterculiaceae

Key to Species

1. Petals pink or violet; pubescence sparse; capsule 5-angled, 5-seeded. *Melochia pyramidata*
1. Petals yellow; pubescence dense; capsule round, 1-seeded
..... *Waltheria indica*

***Melochia pyramidata** L., *Sp. Pl.* 674. 1753.

Distribution.—Uncommon along road to Cerro Evermann trailhead at 350 m (*Levin* 2034); occasional in disturbed soil, El Ranchito, north of Caleta Castelán (*Moran* 25523); common along disturbed roadsides, northeast of Bahía Braithwaite (*Levin* 1783). Texas to Costa Rica, the West Indies, and most of South America, and throughout the Pacific (Sunda Islands, Moluccas, New Guinea, Australia) to the Mascarenes in the Indian Ocean.

These are the first definite records of this species for Socorro. A specimen collected by Barkelew (247; cited by Goldberg 1967) is labeled Socorro but, as Johnston (1931:14) pointed out, probably came from Clarión (see discussion under Botanical Collectors). Because no one found this plant on Socorro between 1903 and 1978, when Moran first collected it, and because it has been found only in disturbed areas, it appears to be a recent arrival.

Waltheria indica L., *Sp. Pl.* 673. 1753.

Waltheria americana L., *Sp. Pl.* 673. 1753.

Distribution.—Abundant in grassy and brushy places in many parts of island, from shore to summit; one of the commonest plants. Pantropical.

Tiliaceae

Key to Species

1. Plants shrubs; fruit subglobose, spiny ... *Triumfetta socorrensis*
1. Plants annual herbs; fruit narrowly oblong to linear, unarmed
 2. Capsule 3-celled, narrowly oblong, 1.5–3 cm long, 3-winged, with 3 long beaks at the apex *Corchorus aestuans*
 2. Capsule 4-celled, linear, 4–7 cm long, unwinged, with 1 short beak at the apex *Corchorus orinocensis*

Corchorus aestuans L., *Syst. Nat.* ed. 10. 1079. 1759.

Distribution.—Occasional in disturbed soil, as at El Ranchito, north of Caleta Castelán (*Moran* 25525), and arroyo bottom, Caleta Castelán near main landing (*Moran* 29497). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1978. Weed throughout the tropics and subtropics, from Florida, the West Indies, and Mexico to South America; Old World tropics.

***Corchorus orinocensis** Kunth in Humb., *Bonpl. & Kunth*, *Nov. Gen. Sp.* 5:337. 1823.

Distribution.—Occasional in dried mud, Caleta Castelán near main landing (*Moran* 29500). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1981. Widespread weed in American tropics, from the West Indies, Texas, and Mexico to South America.

Triumfetta socorrensis T. S. Brandege, *Erythea* 7:1. 1899.

Distribution.—Occasional in open and brushy places from shore to summit. Endemic to Isla Socorro; type without exact locality, *Anthony* 378 (UC 126383).

Remarks.—Growing in brush, this shrub is commonly 1 to 2 m tall. In more exposed places it is smaller; e.g., at the summit of Cerro Evermann plants are semiprostrate and about 3 dm tall.

Lay (1950) considered this a distinct species endemic to Socorro but closely related to *T. brevipes* S. Watson, of southwestern Mexico (Guerrero, Jalisco, and Michoacán).

Verbenaceae

Key to Species

1. Plants herbaceous; flowers in elongate spikes; fruits dry nutlets *Verbena sphaerocarpa*
1. Plants shrubs; flowers in dense heads; fruits drupaceous
 2. Leaves yellowish, orbicular, their apexes rounded *Lantana involucrata*
 2. Leaves greenish, ovate, their apexes acute *Lantana velutina*

Lantana involucrata L. var. *socorrensis* Mold.,

Phytologia 49:431. 1981.

Distribution.—Occasional in brushy places below 100 m in northern part of island (Bahía Academy, Playa Blanca). Endemic to Isla Socorro; type from hillside above the sea, Bahía Academy at 10 m, *Moran* 5890 (MEXU).

Remarks.—Moldenke (1981) cited only the holotype for this variety, but comparison of an isotype at SD with other specimens suggests that all collections of this species from Socorro, most of which had been called *L. involucrata* f. *rubella* Mold., would be assigned to this variety. The variety differs from the typical form of the species in its shorter petioles, smaller and more nearly orbicular leaves, and yellower pubescence. At most, it is a weakly distinct form of a variable species widely distributed around the Caribbean Basin.

Lantana velutina M. Martens & Galeotti, *Bull. Acad.*

Roy. Sci. Bruxelles 11:325. 1844.

Distribution.—Occasional in brushy places near shore (Playa Blanca, Caleta Grayson, Cabo Rule, Bahía Braithwaite) and on the west side up to at least 200 m. Texas south through most of Mexico and Central America.

Remarks.—Moldenke (1980:70) listed both the typical white-flowered form and pale purple-flowered f. *violacea* Mold. from Socorro Island. All the flowering specimens we have seen have pinkish purple flowers.

Verbena sphaerocarpa Perry, *Ann. Missouri Bot. Gard.* 20:256. 1933.

Distribution.—From shore to summit but usually not common. Endemic to Isla Socorro; type without exact locality, *Anthony* 380 (MO).

Remarks.—This is an apparently annual to short-lived perennial herb 7–20 dm tall, simple or few-branched from the base, usually with a few ascending branches above. The spikes are 0.5–4 cm long, on peduncles sometimes as long as 9 cm. According to Mason's notes, quoted by Johnston (1931:88), the flowers on his plants were bluish white, but notes on more recent collections show the flower color to vary from white to bluish, purple, or pink.

Johnston (1931:88) reported this plant as *Verbena litoralis* Kunth, a species ranging from Mexico to southern South America. Perry (1933) and Moldenke (1980:70) separated it as a species known only from Socorro. According to Perry (1933), *V. sphaerocarpa* differs from *V. litoralis* in its shorter and denser spikes, smaller flowers, and shorter but broader nutlets.

Viscaceae

Phoradendron commutatum Trel., *Gen. Phoradendron* 106, pls. 150, 151. 1916.

Phoradendron townsendii Trel., *Gen. Phoradendron* 112, pl. 162. 1916. Type from Isla Socorro without exact locality, *Barkelew* 177 (US).

Distribution.—At low and middle elevations, especially on *Guettarda* but also on *Psidium*, *Prunus*, *Forestiera*, and *Dodonaea*. Sinaloa and San Luis Potosí to Central America.

Remarks.—Vasey and Rose (1890:149) and Brandege (1900b:27) reported this mistletoe as *Phoradendron rubrum* (L.) Griseb., a species described from the West Indies but generally accepted up to Trelease's time as also widespread on the Mexican mainland. Trelease (1916) separated the mainland plant as *P. commutatum* and the Socorro plant as *P. townsendii*. Johnston (1931:59) accepted *P. townsendii* as a very questionable endemic, doubtfully distinct from *P. commutatum*, which in turn he thought scarcely separable from *P. rubrum*.

J. Kuijt examined one of Moran's specimens. He believed (pers. comm.) *P. commutatum*, though related to *P. rubrum*, to be another entity, differing in having only one flower per fertile bract rather than three and in not having the inflorescences clustered at the older nodes. He believed *P. townsendii* probably could be included in *P. commutatum*, though its leaves are perhaps somewhat larger than in mainland material.

Zygophyllaceae

**Tribulus cistoides* L., Sp. Pl. 387. 1753.

Distribution.—Occasional on and near beach at

Caleta Castelán and on disturbed roadsides near Bahía Braithwaite. First collected on Socorro in 1889. Native to the Old World but now a pantropical weed, usually in maritime habitats.

ANGIOSPERMAE: MONOCOTYLEDONS

Key to Families

1. Plant wholly aquatic, immersed in water and rooted to bottom POTAMOGETONACEAE
1. Plant terrestrial or epiphytic, not growing in water
 2. Perianth conspicuous, of 3 sepals and 3 petals, strongly bilateral; plant epiphytic ORCHIDACEAE
 2. Perianth none or of 2 minute scales; plant terrestrial
 3. Stems hollow between nodes; nodes swollen; each flower generally subtended by 2 chaffy bracts; leaves 2-ranked or not in obvious ranks POACEAE
 3. Stems solid; nodes not swollen; each flower subtended by 1 bract; leaves 3-ranked or the stems leafless CYPERACEAE

Cyperaceae

Key to Species

1. Leaves filiform, less than 0.5 mm wide; scales of spikelets spirally imbricated *Bulbostylis nesiotica*
1. Leaves broader, more than 2 mm wide; scales of spikelets in 2 rows
 2. Elongate stolons present, bearing tubers; spikelets strongly compressed, 2 or more times wider than thick *Cyperus rotundus*
 2. Stolons absent; spikelets subcylindric or slightly compressed, 1–1.5 times wider than thick
 3. Spikes subspherical, about as long as wide; spikelets elliptic; rachilla not winged *Cyperus howellii*
 3. Spikes cylindrical, at least 2 times as long as wide; spikelets linear; rachilla winged
 4. Spikelets 2–2.5 mm long, with 3 scales; leaf margins very finely denticulate *Cyperus duripes*
 4. Spikelets 3–7 mm long, with 4–7 scales; leaf margins coarsely scabrous *Cyperus ligularis*

Bulbostylis nesiotica (I. M. Johnston) Fern., Rhodora 40:392. 1938. *Stenophyllus nesioticus* I. M. Johnston, Univ. Calif. Publ. Bot. 7:438. 1922.

Bulbostylis sepiacea Kral, Sida 4:86, fig. 13. 1971. Type from ridge southeast of Cerro Evermann at 950 m, Moran 5838 (UC).

Distribution.—Widespread on island, on brushy hillsides and in rock crevices from shore to summit, sometimes fairly abundant. Endemic to the Revillagigedos; type from Isla San Benedicto (Anthony s. n.).

Remarks.—Kral (1971) compared *B. sepiacea* only with *B. nesiotica*, which he said is much taller and coarser, with broader and stiffer leaves and scapes. He described the two in almost identical terms, except that he called *B. sepiacea* low, rarely 2 dm tall, and *B. nesiotica* coarse, usually 5 dm and sometimes almost 1 m tall. However, a specimen from the summit of Cerro Evermann (Moran 5807), annotated by Kral as *B. sepiacea*, is 3 dm tall, whereas one from Bahía Academy (Moran 5899), annotated by him as *B. nesiotica*, has the tallest culms under 4 dm and some

much shorter. In general, plants growing in brush at lower elevations tend to be taller and more robust than those in open areas above. On the west side of the island, Levin found the distribution nearly continuous from shore to summit and the plants encompassing the complete range of sizes. We find no basis for distinguishing two species.

Although Kral (1971) did not discuss the relationships of *B. nesiotica*, Svenson (1957) thought it probably most closely related to *B. subaphylla* C. B. Clarke, of the Greater Antilles. Earlier, he had thought it closest to *B. vestita* (Kunth) C. B. Clarke, of the West Indies, Mexico, and Central and South America (Svenson 1939).

Cyperus duripes I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:54. 1931.

Distribution.—Widespread on island in rocky places from shore to summit, but not common. Endemic to the Revillagigedos; type from Isla Clarión (Anthony s. n.).

Remarks.—The closest relatives of *C. duripes* appear to be *C. ligularis* L., widely distributed in tropical America and also found on Socorro, and *C. anderssonii* Boeckeler, of the Galápagos Islands (Johnston 1931, Svenson 1939). Svenson felt that *C. anderssonii* was derived from *C. duripes*.

Cyperus howellii O'Neill & Benedict Ayers, Leaf. W. Bot. 4:35. 1944.

Distribution.—Uncommon, on cliffs at or very near coast (Playa Blanca, Bahía Academy, Caleta Grayson, southwest of Cabo Pearce, Caleta Binner, Cabo Rule). Islas Tres Mariás and the adjacent coast of the Mexican mainland; the type is from Mazatlán, Sinaloa.

Remarks.—Johnston (1931:55) and Svenson (1939) reported this plant as *Cyperus* aff. *brunneus* Sw. When O'Neill and Benedict Ayers (1944) described *C. howellii*, they cited *Howell 8415* from Socorro as a paratype.

Cyperus ligularis L., Pl. Jamaic. Pug. 3. 1759.

Distribution.—Locally common in alluvium behind beach berm and in canyon bottoms near shore (Bahía Academy, Playa Blanca, Caleta Grayson, southwest of Cabo Pearce). Widespread in tropical America, always near the coast.

***Cyperus rotundus** L., Sp. Pl. 145. 1753.

Distribution.—Weedy spot in arroyo bed, Caleta Castelán near main landing (Moran 29496). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1981. Cosmopolitan weed.

Orchidaceae

Key to Species

1. Stems slender, about 1 mm thick; leaves up 4.5 cm long and 1.5 cm wide *Pleurothallis unguicallosa*
1. Stems thick, over 5 mm thick; some leaves over 7 cm long and 2 cm wide
 2. Stems pseudobulbous; racemes short, less than 2 cm long, bearing 1-5 flowers; flowers orange-red to orange-yellow; petals and lip about 2 cm long, capsules 4-5 cm long *Cattleya aurantiaca*
 2. Stems not pseudobulbous; racemes longer, to 4-14 cm long, bearing more than 5 flowers; flowers green or yellowish-green; petals and lip 1 cm long or less; capsules 1-2 cm long
 3. Lateral sepals prominently keeled at their apexes; lip slightly contracted in the middle of each side *Epidendrum nitens*
 3. Lateral sepals not keeled; lip not contracted in the middle *Epidendrum rigidum*

Cattleya aurantiaca (Bateman) P. N. Don, Florist's J. 185. 1840.

Distribution.—Epiphytic in forests in upper part of island at 500-800 m. Mexico from Sinaloa south, Central America south to Nicaragua.

Epidendrum nitens Reichb. f., Beitr. Orchid-K. C. Amer. 82. 1866.

Distribution.—Epiphytic in scrub forest on summit plateau near 950 m (Moran 5802). Not previously

reported for Socorro. Guerrero and Vera Cruz to Costa Rica.

Remarks.—Moran's collection, flowering at the University of California Botanical Garden, was identified by G. Newcomb; the identification was later verified by R. L. Dressler, who noted (pers. comm.) that the lateral sepals in the Socorro specimen are quite weakly keeled compared to those of specimens from eastern Mexico.

Epidendrum rigidum Jacq., Enum. Syst. Pl. 29. 1760.

Distribution.—Reported from a collection by Barkelew (233), identified by Charles Schweinfurth. No new collections. Florida, West Indies, central Mexico south through much of South America.

Pleurothallis unguicallosa Ames & C. Schweinf., Proc. Biol. Soc. Wash. 43:195. 1930.

Distribution.—Common epiphyte in forests in upper part of island at about 800-950 m. Endemic to Isla Socorro; type from upper east slope, *Mason 1628* (CAS 186602).

Remarks.—According to Ames and Schweinfurth (1930), *P. unguicallosa* is closest to *P. wilsonii* Lindley of the West Indies, which differs, however, in being smaller throughout, producing one-flowered peduncles, and in having dissimilar petals and lip. They did not iterate the similarities between these species. Williams (1951) stated that the callus, which Ames and Schweinfurth had described as being on the claw, is actually on the base of the lip itself. Apparently on this basis he suggested that *P. xerophila* Schltr. of western Mexico is closely related to *P. unguicallosa*. C. A. Luer (pers. comm.), who is revising *Pleurothallis* and related orchid genera, wrote that because of a lack of good material, particularly preserved flowers, he was unsure of the relationships of *P. unguicallosa*, but doubted that *P. wilsonii* was its closest relative. It is therefore premature to conclude that this species has its closest relationships in the West Indies, which if true would make it unique among Socorro endemics.

Poaceae

Key to Species

1. Spikelets unisexual, the staminate and carpellate spikelets conspicuously different, in separate inflorescences and usually on separate plants; carpellate spikelets embedded in the hard thickened rachis *Jouvea pilosa*
1. Spikelets bisexual or if unisexual then the staminate and carpellate spikelets not conspicuously different; carpellate spikelets not embedded in rachis
 2. Spikelets subtended or surrounded by bristles and/or spines
 3. Bristles separate, persistent on the plant when the spikelets fall *Setaria geniculata*
 3. Bristles and spines united at base or above to form an involucre or bur that falls with the enclosed spikelets
 4. Spines flattened, united for much of their length to form a hard bur, subtended by retrorsely barbed bristles *Cenchrus echinatus*
 4. Spines not flattened, united only at base
 5. Spines conspicuously ciliate-pubescent *Cenchrus ciliaris*
 5. Spines retrorsely barbed, not ciliate *Cenchrus myosuroides*

2. Spikelets not subtended or surrounded by bristles or spines
 6. Spikelets in clusters of 3, the central spikelet bisexual, the lateral spikelets staminate or sterile, the whole cluster falling as a unit *Aegopogon solisii*
 6. Spikelets not in a cluster falling as a unit
 7. Spikelets with 3 or more fertile florets
 8. Spikelets sessile, in 1-sided spikes; spikes digitate at stem apex *Dactyloctenium aegyptium*
 8. Spikelets pedicelled, not in 1-sided spikes; spikes in a panicle with rebranched branches
 9. Paleas finely ciliolate on the nerves, the cilia less than 0.1 mm long *Eragrostis pectinacea*
 9. Paleas conspicuously ciliate on the nerves, the cilia 0.2–0.5 mm long
 10. Panicles interrupted, spikelike, 0.5–1 cm thick, the branches and pedicels appressed; pedicels much shorter than the spikelets *Eragrostis ciliaris*
 10. Panicles open, 1.5–3 cm wide, the branches and pedicels spreading; pedicels mostly longer than the spikelets *Eragrostis tenella*
 7. Spikelets with 1 fertile floret
 11. Spikelets in pairs, 1 sessile or subsessile and fertile, the other pedicelled, reduced, staminate, neuter, or represented only by the pedicel; first glume large and firm, enclosing margins of second glume; lemma of perfect floret thin and membranous
 12. Awns 7–12 cm long *Heteropogon contortus*
 12. Awns less than 3 cm long
 13. Inflorescence a single spikelike raceme partially enclosed in a sheath, sheath-bearing branches 1–several; pedicellate spikelet neuter *Schizachyrium sanguineum*
 13. Inflorescence a panicle; pedicellate spikelet represented only by pedicel *Sorghastrum nutans*
 11. Spikelets variously arranged, if in pairs then pedicelled spikelet not reduced and first glume not larger and firmer than lemma of perfect floret
 14. Glumes and/or lemmas awned
 15. Awn 3-branched
 16. Glumes markedly unequal, the first 5–7 mm long, the second 7–10 mm long; plants annual, branching at most lower nodes *Aristida adscensionis*
 16. Glumes subequal, both about 10–14 mm long; plants perennial, tufted but not branching at lower nodes *Aristida vaginata*
 15. Awns simple, not branched
 17. Spikelets not silky-villous; first glume well-developed, with an awn 3 times as long as the body *Oplismenus hirtellus*
 17. Spikelets silky-villous with rosy hairs that fade white; first glume minute, awnless *Rhynchelytrum repens*
 14. Glumes and lemmas all awnless
 18. Inflorescence with the primary branches rebranched, not 1-sided *Sporobolus purpurascens*
 18. Inflorescence with 1-sided spikelike lateral branches
 19. Inflorescence racemose; margins of lemma of fertile floret thick and inrolled over palea margins *Paspalum longum*
 19. Inflorescence digitate; margins of lemma of fertile floret thin, not inrolled over palea margins
 20. Rachis not winged; spikelets all sessile, similar in appearance; lemmas not developing a fringe of long hairs; spikelets disarticulating between the glumes and floret *Cynodon dactylon*
 20. Rachis winged; spikelets in unequally pedicelled pairs; lemmas of long-pedicelled spikelets conspicuously pectinate-fringed at maturity; spikelet disarticulating below the glumes, the glumes falling with the florets *Digitaria bicornis*

Aegopogon solisii Levin, sp. nov. (Figure 18)

Type.—Isla Socorro, Mexico: inconspicuous but fairly common along trail and in other places, east slope at 980 m near summit of Cerro Evermann, near 18°46.5'N, 110°57.5'W, 4 April 1981, *Moran 29504* (holotype: SD 118728; isotypes: CHAPA, MO, US).

Gramen annuum caespitosum. Culmi graciles inferne ramosi prope basin decumbentes et e nodis inferioribus radicanes dein erecti 5–20 cm alti glabri. Foliorum vaginæ glabrae laeves; ligulae membranaceae laceratae 0.7–1.0 mm longae; laminae planae supra scabrello-pubescentes 2–6 cm longae 0.8–1.2 mm latae. Inflorescentia racemiformis 2.5–4.0 cm longa; spicularum fasciculi 1.5–2.0 mm longi (pedunculo aristisque exclusis), quisque ex 3 spiculis constans, spicula fertili una sessili, spiculis masculis neutrivse 2 ca. 1 mm pedicellatis. Glumae cuneatae apice bilobatae, lobis obtuse deltoideis aristatis, aristis corpore subaequalibus. Lemma fertile 1.5–1.8 mm longum triaristatum, arista media 4.5–5.0 mm longa, aristis lateralibus 0.8–0.9 mm longis. Lemmata sterilia glumis similia 0.5–0.8 mm longa, aristis 1.0–1.3 mm longis. Antherae 0.3–0.8 mm longae. Typus: *Moran 29504* (SD 118728). Species *Ae. cenchroidi* affinis sed spicularum fasciculis brevioribus, glumarum lobis latioribus, et antheris brevioribus differt.

Tufted annual grass. Culms slender, glabrous, 5–20 cm tall, branching below, curved near base and rooting at lower nodes, erect above. Leaf sheaths smooth and glabrous; ligules membranaceous, 0.7–1.0 mm long, the apex lacerate; blades thin, flat, 2–6 cm long below, reduced in length upwards, 0.8–1.2 mm wide, greenish and glabrous or scabrous on nerves beneath, purplish and scabrelloous-puberulent above. Inflorescences racemose, 2.5–4.0 cm long, somewhat interrupted below, with 18–30 short-peduncled spikelet clusters. Spikelet clusters purplish, 1.5–2.0 mm long exclusive of awns and hispid peduncle, of three spikelets, one sessile or nearly so and fertile, the other two on hispid pedicels 0.8–1.0 mm long, staminate or neuter, one sometimes smaller than the other. Glumes of fertile spikelet pubescent on back, the body cuneate, 0.9–1.1 mm long, 0.25–0.30 mm wide, the apex deeply lobed, the lobes deltoid, narrowly obtuse, the awn from notch



scabrous, 0.7–1.1 mm long. Fertile lemma puberulent on back, 1.5–1.8 mm long, 3-nerved, the lateral nerves ending in scabrous awns 0.8–0.9 mm long, the midnerve ending in scabrous awn 4.5–5.0 mm long. Fertile palea ca. as long as lemma, minutely hispid on back between nerves, with two apical scabrous awns 0.6–0.8 mm long. Anthers 0.3–0.8 mm long. Grain light brown, 0.9–1.0 mm long, 0.25 mm broad, the style base persistent as minute callus. Glumes of staminate or neuter spikelets minutely scabrous, similar in shape to those of fertile spikelet, 0.3–0.5 mm long, the awn 0.4–0.6 mm long. Sterile lemma similar in shape to glumes, 0.5–0.8 mm long, the awn 1.0–1.3 mm long. Sterile palea ca. as long as lemma, truncate.

Paratypes.—All from near summit of Cerro Evermann: ca. 1020 m, *Levin 2042* (CIB, SD); *Miranda 8745* (MEXU); ca. 1000 m, *Moran 5833* (ISC, SD, TAES, US); ca. 800 m, *Solis 90* (MEXU, US).

Distribution.—Endemic to Isla Socorro. Locally common in the summit grassland from ca. 800 m to the summit of Cerro Evermann.

Remarks.—*Aegopogon solisii* is most similar to *Ae. cenchroides* Humb. & Bonpl., which ranges from southern Baja California and Arizona through most of Mexico to Central and northern South America. From both varieties of *Ae. cenchroides*, the Socorro plant is distinguished by its small spikelet clusters not over 2 mm in length, glumes with obtuse lobes and awns not much longer than the body, and small anthers (0.3–0.8 mm vs. 1.5–1.8 mm). Furthermore, *Ae. solisii* differs in having the awns on the fertile lemma 2.5–3 times the length of the body rather than only about as long as the body, as in *Ae. c. cenchroides*, or 3–4 times as long, as in *Ae. c. breviglumis* (Scribner) Beetle. The small spikelet clusters, sessile fertile spikelets, and narrow lobes on the glumes immediately distinguish *A. solisii* from the only remaining North American *Aegopogon*, *Ae. tenellus* (DC.) Trin.

It is a pleasure to name this new species after Octavio Solís, late Director of the Botanical Garden in Mexico City, whose collections from Socorro, including the earliest specimen of this species, have been overlooked for so long.

***Aristida adscensionis* L., Sp. Pl. 82. 1753.**

Distribution.—Common on lower hills at south end of island (near airport, near Caleta Binner, Cabo Rule, near Caleta Castelán), abundant on overgrazed area north of Huerta Grande at 300–450 m. Widespread from the southwestern United States throughout

Mexico, Central America, West Indies, and much of South America; also in the warmer parts of the Old World.

***Aristida vaginata* A. Hitchc., Proc. Calif. Acad. Sci., ser. 4, 21:297. 1935.**

Distribution.—Fairly common in grassy areas near coast; occasional to summit. Endemic to Isla Socorro; type from dry slopes at Bahía Academy, *Howell 8448* (CAS 211474). Although Díaz Pulido (1967:58) reported this species from Jalisco, McVaugh (1983:65) rejected this report.

Remarks.—Johnston (1931:51) reported *Aristida pansa* Wootton & Standley from Clarión and Socorro. The specimen from Clarión was identified by A. S. Hitchcock, who said it differed from mainland material only in minor details; hence he included the Revillagigedos in the range of *A. pansa* (Hitchcock 1935a). On the basis of Howell's later collections, however, Hitchcock (1935b) described *A. tenuifolia* from Clarión and *A. vaginata* from Socorro. He said *Aristida tenuifolia* differed from *A. vaginata* "in its more slender culms about 60 cm tall, its narrower mostly involute blades, with scattering hairs on the upper surface near the base, and looser shorter panicles. The spikelets are similar, though the awns are somewhat shorter and are finally widely spreading."

Because specimens collected by Felger (15808) and Moran (5740, 5901, 25461, 29518, 29544) differ from the original description in some details, it may be well to mention these details to give a better idea of the variation of the plant. Plants 4–8 dm tall; culms 1–1.5 mm thick; blades 1.5–4 mm wide, with a few long weak hairs on upper surface near base; panicle 18–30 cm long; first glume 10–14 mm long; second glume 10–14 mm long (including awn), bifid for ca. 0.5 mm, with single awn 1–1.5 mm long; lemma ca. 10 mm long to forking of awn, the upper 3 mm twisted, not always lighter in color; central awn 18–38 mm long; lateral awns ca. 13–28 mm long. Thus it appears that the variation in the Socorro plants reduces some of the supposed differences between *A. tenuifolia* and *A. vaginata*.

Though Hitchcock (1935b) did not compare his new species with *A. pansa* or with any other mainland species, it would appear that the closest relative of *A. vaginata* on the mainland is *A. pansa*, which differs mainly in having more open panicles. Certain placement awaits a critical revision of the genus. The range of *A. pansa* is from Arizona and Sonora east and south to Texas, Puebla, and Oaxaca.

Fig. 18. *Aegopogon solisii*. A, habit; B, lateral view of spikelet cluster, showing one sessile fertile spikelet and one of the two pedicellate staminate or neuter spikelets; C, fertile spikelet; D, staminate spikelet; E, highly reduced neuter spikelet (all *Moran 29504*, the holotype).

**Cenchrus ciliaris* L., Mant. Pl. 302. 1771.

Distribution.—Common in disturbed areas north of Bahía Braithwaite (Levin 1759) and near the naval base (Dominguez 706). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1987. Weed in southern United States and much of lowland Mexico; introduced from the Old World.

**Cenchrus echinatus* L., Sp. Pl. 1050. 1753.

Distribution.—Common in disturbed sites at south end of island near Caleta Castelán (Moran 5744, 25449, 29489), Bahía Braithwaite (Levin 1764), and along airport road up to at least 250 m (León 3449). Not previously reported for Socorro and evidently a recent arrival. Moran found only one plant in 1957, the year the naval base was established, but by 1978 the species had spread along roadsides around Caleta Castelán, and by 1988 it was well established along roadsides elsewhere on the south side. This weedy grass is widespread in the tropics of both hemispheres.

Cenchrus myosuroides Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 1:115. 1815.

Distribution.—Common at low elevations (Cabo Henslow, Caleta Grayson, Caleta Binner, Cabo Rule, Caleta Castelán, Bahía Braithwaite). Widely distributed from the southeastern United States through Mexico and the West Indies to southern South America.

**Cynodon dactylon* (L.) Pers., Syn. Pl. 1:85. 1805.

Distribution.—Occasional in disturbed sites in southern part of island: north of Huerta Grande (Moran 29532), roadside near Laguna Escondida (Moran 29542), and planted as lawn and escaping at naval base, Cabo Rule (Dominguez 705, Moran 25439). Not previously reported for Socorro and evidently a recent introduction; first collected there in 1978. Widely distributed in the New World; introduced from Africa.

**Dactyloctenium aegyptium* (L.) Willd., Enum. Pl. 1029. 1809.

Distribution.—Occasional in southern part of island, as in overgrazed area north of Huerta Grande (Dominguez 712), at east side of Laguna Escondida (Moran 29539), along airport road at 250 m (León 3441), at Caleta Binner (Carlquist 373; Moran 5738), and at Bahía Braithwaite (Levin 1769). Not previously reported for Socorro; first collected there in 1955. Native to the Old World tropics; now widespread from the southern United States through Mexico and the West Indies to South America.

**Digitaria bicornis* (Lam.) Roemer & Schultes, Syst. Veg. 2:470. 1817.

Distribution.—Occasional in southern part of island,

as in overgrazed area north of Huerta Grande (Dominguez 713), along airport road at 250 m (León 3457), in disturbed areas north of Bahía Braithwaite (Levin 1765), and in arroyo at Caleta Castelán near main landing (Moran 29492). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1981. Widespread weed throughout the tropics and subtropics of the world, apparently introduced to North America from Asia.

**Eragrostis ciliaris* (L.) R. Br. in Tuckey, Narr. Exp. Congo App. 478. 1818.

Distribution.—Widespread on island from shore to summit, but not common. First found on island in 1903 and near summit in 1957. Widespread in warm regions of the world, apparently introduced in the Americas.

**Eragrostis pectinacea* (Michaux) Nees, Fl. Afr. Austral. Ill. 1:406. 1841.

Distribution.—Uncommon in overgrazed area north of Huerta Grande (Dominguez 714). Not previously reported for Socorro and evidently a recent arrival; first collected there in 1988. Widespread weed from eastern, central, and southwestern United States through most of Mexico to Central America and the West Indies.

**Eragrostis tenella* (L.) P. Beauv. ex Roemer & Schultes, Syst. Veg. 2:576. 1817.

Eragrostis amabilis (L.) Wight & Arn. ex Nees in Hook. & Arn., Bot. Beechey Voy. 251. 1838.

Distribution.—Occasional in southern part of island at elevations below ca. 500 m, generally near shore. First collected on Socorro in 1957. Reported from Socorro by Miranda (1960:132) as *E. amabilis*. Common pantropical weed, native to the Old World.

Heteropogon contortus P. Beauv. ex Roemer & Schultes, Syst. Veg. 2:836. 1817.

Distribution.—Common near shore on south and west sides of island (Caleta Grayson, Cabo Rule, Caleta Castelán). According to Mason's notes (quoted by Johnston 1931:54), this grass also is abundant on upper west slope of Cerro Evermann, but Levin saw none there and all collections are from elevations below 75 m. Widespread in tropical and subtropical regions of both hemispheres.

Jouvea pilosa (C. Presl.) Scribner, Bull. Torrey Bot. Club 23:143. 1896.

Distribution.—Common along upper beach and occasional on hillsides to 75 m (Bahía Academy, Playa Blanca, Caleta Grayson, southwest of Cabo Pearce, Caleta Binner, Caleta Castelán). Sandy beaches from southern Baja California and Sonora to Nicaragua.

Oplismenus hirtellus (L.) P. Beauv., Ess. Agrostogr. 54, 168. 1812.

Distribution.—Locally common in shade under *Pteridium*, upper east slope of Cerro Evermann above *solfataras*, ca. 1000 m (Levin 1822). Not previously reported for Socorro. Southeastern United States, West Indies, Baja California, Sonora, eastern and southern Mexico to southern South America; also in the Old World.

Remarks.—This shade-loving grass grows in the same vicinity as *Hibiscus diversifolius*. Because both Felger and Moran collected the hibiscus but not *Oplismenus*, it is possible that the grass is a recent arrival to Socorro. Unlike the hibiscus with its erect habit and showy flowers, however, this prostrate grass is not easily seen from the trail through the dense bracken thicket. Nor does this site seem a likely place for a new plant to land on the island. We therefore tentatively interpret *O. hirtellus* as a native previously overlooked.

Paspalum longum Chase in I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 20:52. 1931.

Distribution.—Uncommon in grassy areas at low elevations near south end of island (overgrazed area north of Huerta Grande, southwest of Cabo Pearce, Caleta Binner, Cabo Rule, Caleta Castelán). Endemic to Isla Socorro; type from grassy flat north of Caleta Binner, *Mason 1648* (CAS 186603).

Remarks.—According to Chase (*in* Johnston 1931:53), *P. longum* is most closely related to *P. arundinaceum* Poiret, of the West Indies, eastern Guatemala, and French Guiana.

***Rhynchelytrum repens** (Willd.) Hubb., Bull. Misc. Inform. 1934:110. 1934.

Distribution.—Common on roadsides and invading nearby undisturbed vegetation at south end of island, as at Huerta Grande (*Moran 29537*), north of Bahía Braithwaite (*Levin 1760*), at Caleta Castelán near main landing (*Moran 29494*), near the naval base (*Dominquez 756*), and along the road from the naval base to the airstrip. Not previously reported for Socorro and evidently a recent arrival. Widespread in warm regions of both hemispheres, generally in disturbed habitats; native to Africa.

Remarks.—When first collected on the island in 1981, this grass was only occasional. By 1987 it was common in disturbed places throughout the south end of the island. It is one of the few weeds capable of invading undisturbed vegetation and has become a conspicuous part of the *Croton* scrub at least 30 m from the roads.

Schizachyrium sanguineum (Retz.) Alston, Suppl. Fl. Ceylon 334. 1931, var. **sanguineum**

Schizachyrium semiberbe Nees, Agrost. Bras. 336. 1829.
Andropogon semiberbis (Nees) Kunth, Révis. Gramin. Suppl. 39. 1830.

Distribution.—Locally common in grassy places and in low scrub from shore to summit, as above Playa Blanca (*Moran 25484*), at Caleta Grayson (*Moran 5934, 25452*), on ridge northwest of Cerro Evermann (*Levin 1813*), on south slope of Cerro Evermann (*Felger 15766; Moran 5812*), and near Caleta Castelán (*Howell 8422*). Not previously reported for Socorro. Southeastern United States, West Indies, eastern and southern Mexico to South America; Old World tropics.

Remarks.—We follow Hatch (1978) in treating the New World *S. semiberbe* as a synonym of the typical form of the Old World *S. sanguineum*. Hatch kindly checked Felger's and Moran's specimens.

Setaria geniculata (Lam.) P. Beauv., Ess. Agrostogr. 51, 169, 178. 1812.

Distribution.—Fairly common in brushy areas in upper half of island, from 500 m to summit. Widespread from the northern United States through Mexico and the West Indies to South America.

Sorghastrum nutans (L.) Nash in Small, Fl. S.E. U.S. 66. 1903.

Distribution.—Locally common from shore at north end (Bahía Academy, Playa Blanca) to summit. Southern Canada, through all but the extreme western United States, and Mexico to South America.

Sporobolus purpurascens (Sw.) W. Ham., Prod. Pl. Ind. Occ. 5. 1825.

Distribution.—Apparently local near summit of island. Southeastern United States, West Indies, Veracruz, Chiapas (Beetle 1977), and Central America to Peru. McVaugh (1983:377) rejected Díaz Pulido's (1967:231) report of the species from Jalisco.

Remarks.—The identifications of all collections have been verified, one (*Mason 1663*) by A. Chase and the rest (*Felger 15775, 15811; Moran 5848*) by C. G. Reeder.

Potamogetonaceae

Potamogeton nodosus Poiret in Lam., Encycl. suppl. 4:535. 1816.

Distribution.—Tinaja in steep-walled cañon south of Bahía Academy at 40 m (*Moran 5874*). The determination was verified by E. C. Ogden. Not previously reported for Socorro. Widespread from southern Canada through most of the United States to the West Indies, Mexico, and South America; also in Eurasia and Africa.

EXCLUDED SPECIES

The following species, reported from Socorro on the basis of Barkelew's collections, have not been found on Socorro (see discussion under Botanical Collectors):

Convolvulaceae

- Ipomoea indica* (Burm. f.) Merr. (Barkelew 245, in part)
I. halierca I. M. Johnston (Barkelew 245, in part)

Fabaceae

- Sophora tomentosa* L. (Barkelew 246)

Mason (1951:416) attributed the genus *Linanthus* (Polemoniaceae) to Socorro. He told Moran that he had found fragments of an unidentifiable *Linanthus* among some scrappy plant material brought supposedly from Socorro by a casual visitor. Apparently no specimen was kept, and he considered the record too uncertain to be maintained.

Mason's collections from his 1925 trip to Isla Socorro bear labels headed "Expedition to the Revillagigedos Islands." As a result, some plants collected elsewhere on the trip are erroneously reported for the Revillagigedos, though not specifically for Socorro. We have noted four thus far. Three are really from Bahía Magdalena, Baja California Sur: *Gossypium klotzschianum* var. *davidsonii* (Kellogg) Hutch. (Hutchinson 1947:23; cf. Moran 1961), *Perityle emoryi* Torrey (Powell 1974), and *Physalis crassifolia* Benth. (Waterfall 1967). The fourth, *Stegnosperma cubense* A. Rich. (Rogers 1949), is from Isla Isabela, Nayarit (Moran 1961).

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APPENDIX 1

Vascular Flora of Isla Clarión

This list is based on Johnston (1931), with the names brought up to date. The known flora includes 41 native species and 1 introduced species (marked with asterisk).

Ferns

Polypodiaceae

Cheilanthes peninsularis Maxon var. *insularis* Weath.
Endemic to islas Clarión and Socorro.

Dicotyledons

Aizoaceae

Sesuvium portulacastrum L.

Amaranthaceae

Iresine diffusa Humb. & Bonpl. ex Willd. Reported by Johnston (1931) as *I. celosia* L., but this name is illegitimate (Shinners 1962).

Asteraceae

Brickellia peninsularis T. S. Brandegee var. *amphithalassa* Robinson ex I. M. Johnston. Endemic to islas Clarión and Socorro.

Perityle socorrosensis Rose. Endemic to Revillagigedos.

Boraginaceae

Heliotropium curassavicum L.

Brassicaceae

Lepidium lasiocarpum Nutt. ex Torrey & A. Gray var. *latifolium* C. Hitchc.

Cactaceae

Opuntia sp. Probably the same undescribed species as on Socorro.

Convolvulaceae

Cressa truxillensis Kunth. As Johnston (1931:14) pointed out, Barkelew's specimen (252), labeled Socorro, probably came from Clarión instead (see discussion under Botanical Collectors). Barkelew 252 (US) is the type of *Cressa insularis* House.

Ipomoea halierea I. M. Johnston. Endemic to Isla Clarión.

I. indica (Burm. f.) Merr. Reported by Johnston (1931) as *I. cathartica* Poirét, a synonym.

I. pes-caprae (L.) Sweet subsp. *brasiliensis* (L.) Ooststr.

Euphorbiaceae

Chamaesyce anthonyi (T. S. Brandegee) Levin. Endemic to Revillagigedos. Reported by Johnston (1931) as *Euphorbia anthonyi* T. S. Brandegee var. *clarionensis* (T. S. Brandegee) I. M. Johnston, a synonym.

Euphorbia californica Benth. var. *californica*

Fabaceae

Caesalpinia bonduc (L.) Roxb. Reported by Johnston (1931) as *C. crista* L., a synonym.

Calliandra socorrensis I. M. Johnston. Endemic to islas Clarión and Socorro.

Canavalia rosea (Sw.) DC. Reported by Johnston (1931) as *C. apiculata* Piper, a synonym.

Galactia striata (Jacq.) Urban

Macroptilium atropurpureum (DC.) Urban. Reported by Johnston (1931) as *Phaseolus atropurpureus* DC., a synonym.

Sophora tomentosa L.

Lamiaceae

Teucrium townsendii Vasey & Rose var. *townsendii*. Endemic to Isla Clarión.

Malvaceae

Malvella leprosa (Ortega) Krapov. Reported by Johnston (1931) as *Sida hederacea* (Douglas) Torrey, a synonym.

Nyctaginaceae

Boerhavia coccinea Miller. Reported by Johnston (1931) as *B. caribaea* Jacq., which we regard as a synonym.

Portulacaceae

Portulaca pilosa L.

Rhamnaceae

Karwinskia humboldtiana (Roemer & Schultes) Zucc.

Rubiaceae

Spermacoce nesiotica (Robinson) Levin. Endemic to islas Clarión and Socorro. Reported by Johnston (1931) as *Borreria nesiotica* Robinson, the basionym.

Rutaceae

Zanthoxylum fagara (L.) Sarg.

Sapindaceae

Cardiospermum halicacabum L.

Dodonaea viscosa Jacq.

Sapindus saponaria L.

Solanaceae

Nicotiana stocktonii T. S. Brandegee. Endemic to islas Clarión and Socorro.

Physalis clarionensis Waterf. Endemic to Isla Clarión. Reported by Johnston (1931) as *P. angulata* L.

Sterculiaceae

Melochia pyramidata L.

Waltheria indica L. Reported by Johnston (1931) as *W. americana* L., a synonym.

Zygophyllaceae

**Tribulus cistoides* L. Native to Old World, but established on Clarión by 1889.

Monocotyledons

Commelinaceae

Commelina erecta L. var. *angustifolia* (Michaux) Fern. Reported by Johnston (1931) as *C. virginica* L., which was a common misapplication of Linnaeus' name.

Cyperaceae

Bulbostylis nesiotica (I. M. Johnston) Fern. Endemic to Revillagigedos. Reported by Johnston (1931) as *Stenophyllus nesioticus* I. M. Johnston, the basionym.

Cyperus duripes I. M. Johnston. Endemic to Revillagigedos.

Scirpus maritimus L. var. *paludosus* (Nelson) Kük. Reported by Johnston (1931) as *S. robustus* Pursh var. *paludosus* (Nelson) Fern., a synonym.

Poaceae

Aristida tenuifolia A. Hitchc. Endemic to Isla Clarión. Reported by Johnston (1931) as *A. pansa* Wooton & Standley.

Eriochloa acuminata (C. Presl.) Kunth

Sporobolus pyramidatus (Lam.) A. Hitchc. Reported by Johnston (1931) as *S. argutus* (Nees) Kunth, a synonym.

Excluded Species

Goodeniaceae

Scaevola plumieri (L.) Vahl. Reported by Johnston (1931:98) on the basis of *Anthony 387*, which we believe came from Isla Socorro (see discussion under this species in the Catalogue). The plant has not otherwise been recorded on Clarión.

APPENDIX 2

Vascular Flora of Isla San Benedicto

This list is based on Johnston (1931), with the names brought up to date. The eruption of Volcán Bárcena in 1952 severely disrupted the flora of the island (Brattstrom 1963). Later erosion of the loose volcanic ash may have eliminated some species that survived the eruption, but at least one seems to have recolonized the island. The total flora, formerly of 10 known species, now appears to stand at six (Brattstrom 1963, pers. comm.). Each species thought possibly extinct on the island is marked with a dagger.

Dicotyledons

Aristolochiaceae

†*Aristolochia islandica* Pfeifer. Endemic to Isla San Benedicto. Reported by Johnston (1931) as *A. brevipes* Benth. Survived the eruption but has not been seen since 1956 and possibly is extinct.

Asteraceae

Erigeron crenatus Eastwood ex I. M. Johnston. Endemic to Isla San Benedicto. Not reported by Brattstrom (1963), but collected in 1978 (Moran 25554).

Perityle socorrosensis Rose. Endemic to Revillagigedos.

Convolvulaceae

Ipomoea pes-caprae (L.) Sweet subsp. *brasiliensis* (L.) Ooststr. Not known to have survived the eruption, but recolonized by 1961.

Euphorbiaceae

Chamaesyce anthonyi (T. S. Brandegee) Levin. Endemic to Revillagigedos. Reported by Johnston (1931) as *Euphorbia anthonyi* T. S. Brandegee var. *anthonyi*, a synonym. Survived the eruption, was not seen between 1956 and 1971, but was found again in 1978. Brattstrom (pers. comm.) suggested

it recolonized, but we think very likely it was overlooked before.

Lamiaceae

†*Teucrium townsendii* Vasey & Rose s.l. Johnston (1931) treated the San Benedicto plant as the endemic variety *T. affine* T. S. Brandegee var. *dentosum* I. M. Johnston. Possibly a subspecies. Not known to have survived the eruption and possibly is extinct on the island.

Monocotyledons

Cyperaceae

†*Bulbostylis nesiotica* (I. M. Johnston) Fern. Endemic to Revillagigedos. Reported by Johnston (1931) as *Stenophyllus nesioticus* I. M. Johnston. Not known to have survived the eruption and possibly is extinct on the island.

Cyperus duripes I. M. Johnston. Endemic to Revillagigedos.

Poaceae

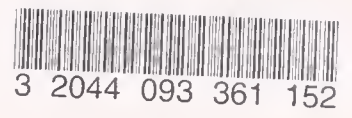
†*Cenchrus myosuroides* Kunth. Survived the eruption but has not been seen since 1956 and possibly is extinct on the island.

Eragrostis diversiflora Vasey. Considered a synonym of *E. prolifera* (Sw.) Steudel by McVaugh (1983:172).

Excluded Species

Sapindaceae

Dodonaea viscosa Jacq. Cited with considerable doubt by Johnston (1931:73) on the basis of *Barkeley 188*, which we believe came from Socorro (see discussion under Botanical Collectors). The plant has not otherwise been recorded on San Benedicto.



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